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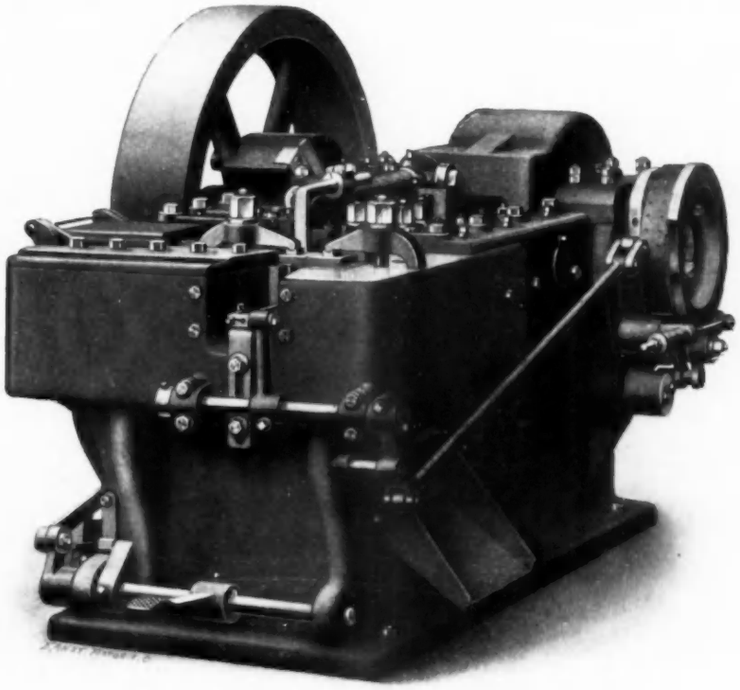

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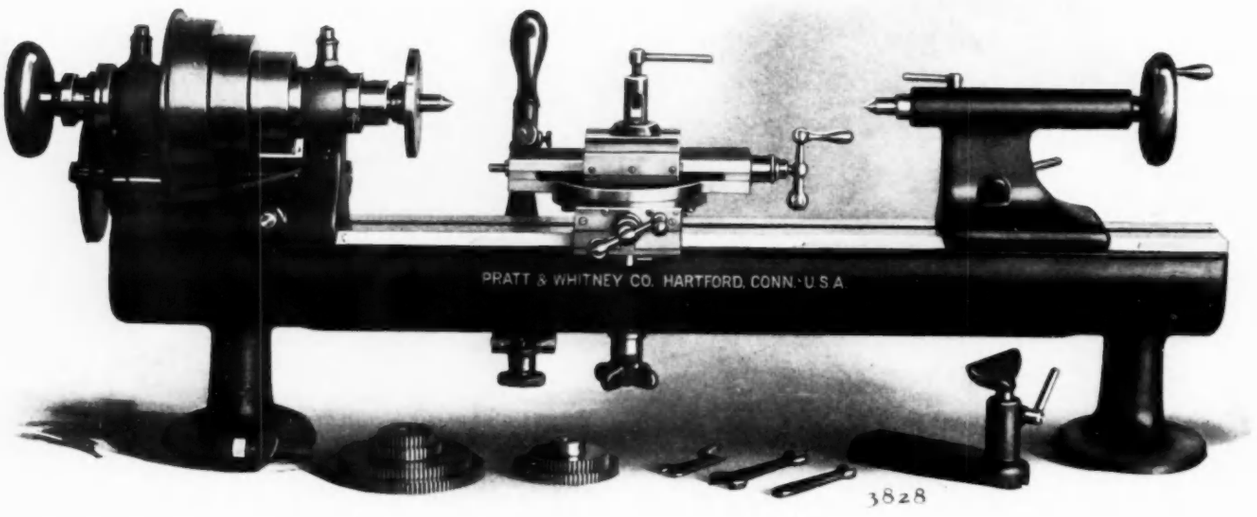

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A Twin Chambered High-speed Furnace

Either Gas or Oil for Fuel. Upper Chamber at Low Temperature for Preheating, Lower at Very High Temperature for Hardening

BY S. N. BRAYSHAW

A new patented furnace for hardening high-speed steel, that has two heating chambers, one of which is located on top of the other, has just begun to be manufactured for sale by S. N. Brayshaw, 2 Mulberry street, Hulme, Manchester, Eng. These furnaces are sold by the George Nash Company, 217 Pearl street,

FIG. 1. TWIN CHAMBERED GAS-BURNING FURNACE

New York, who have the American agency.

This furnace has been designed throughout with as much care as is commonly given to machine tools and there are many convenient arrangements about it that will not be gone into in detail, but they can be seen by a perusal of the half-tones of the furnace that uses gas for fuel as shown in Fig. 1, and the one using oil for fuel as shown in Fig. 2 with its accompanying oil tank and connections.

The furnaces proper are both built exactly alike, but the mixing chambers, burners, valves, pipe connections and the table on which these, as well as the furnaces, are located are different for each design. As can be plainly seen in Fig. 2 the inlet through which the oil or gas enters the furnace is fastened on the side of it by four bolts and the mixing chamber with its burner is located close to the inlet. These inlets are of different designs for the oil and gas as will be explained later.

Construction of Furnace

The furnaces are made of a special firebrick and these are bound together at the corners with a framework constructed of angle irons. The opening in the upper or preheating chamber is closed by a door made of firebrick held in an iron frame and it has a balancing weight to hold it open. The lower chamber opening is closed by two sliding doors of firebrick inclosed in an iron frame and hung on a rod. Thus the doors always present the cool side to the operator with the heated side next to the furnace.

The lower chamber can be maintained at a temperature of 1400 degrees Centigrade or 2550 degrees Fahrenheit by using coal gas or oil for fuel, but producer gas will not give this high temperature. The upper chamber is heated by the waste gases from the lower chamber and will heat steel to a dull red color.

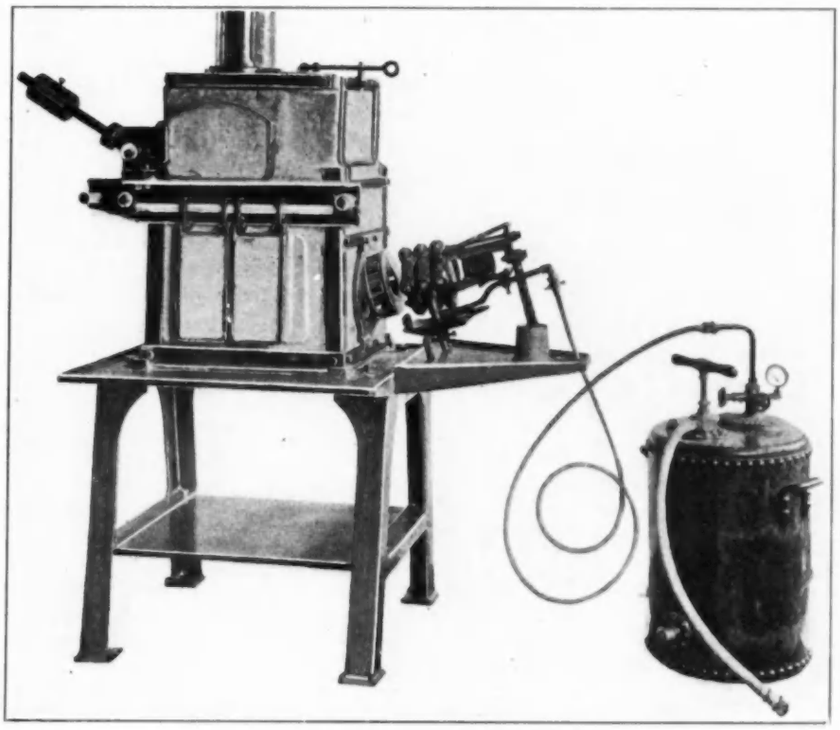


FIG. 2. TWIN CHAMBERED OIL-BURNING FURNACE

The upper chamber is 15 inches wide, 12 inches deep and 10 inches high, with a doorway 9 inches wide and 6¼ inches high. The lower chamber is 15 inches wide, 12 inches deep and 12 inches high, with a doorway 9 inches wide and 7¾ inches high.

The gas furnace has a 2-inch diameter to its gas supply and consumes about 600 cubic feet per hour. The air pressure is one pound to the square inch and the consumption of compressed air, measured at normal pressure is 1500 cubic feet per hour. Its net weight is about 1500 pounds.

The oil-burning furnace has the same sized chambers and doorways as the gas furnace and it is provided with one spare oil-burner. The consumption of oil is 2¼ gallons per hour. Its net weight is about 1550 pounds.

Gas-mixing Chamber

The most interesting part of these furnaces are the gas and air nozzles and the mixing chamber, and these are shown in Fig. 3. The mixing chamber shown on an angle of 15 degrees at *B*, Fig. 3, had a very great deal of thought and labor expended in its designing and is the result of many trials and modifications. All the essential particulars are fully shown with their actual dimensions.

The purpose for which this burner is to be used makes it necessary that the details should be very well arranged. The main proportions in the design of a burner may be readily calculated but in

a special burner of this character there are some details, after all, which can only be ascertained by trial and yet they are essential to success.

Although the figure referred to appears very simple there are some important points about it; for instance, there is shown at *A*, at the top of the drawing near the center, a design of nozzle which differs but little from the one below and yet the nozzle shown at *A* is unsuitable for the work. Indeed it is very surprising to find what a great difference in working there is between the two nozzles. By using nozzle *A* it is not possible to reach such a high temperature as with nozzle *B*, other conditions being equal; besides which it is practically impossible for the correct nozzle to "light back" whereas nozzle *A* tends to "light back" continually and causes difficulty in other ways, as will readily be understood by gas engineers and others who have made a study of burners.

It is essential in designing the burner for a high-speed furnace that provision should be made for the gas and the air to be mixed most intimately before they enter the furnace. Referring again to *B*, Fig. 3, you will see a mixing chamber with an internal diameter of 3 inches. A jet of compressed air is discharged from a half-inch nozzle, into the center of this mixing chamber, and thereby it induces a rapid stream of gas which encircles the central jet, and again outside of the stream of gas there is an induced flow of air.

Causes that Produce Good Mixture

It will be seen that the arrangement described above readily lends itself to the admixture of the gas and the air as they pass along the mixing chamber. This admixture is, of course, greatly assisted by the wire gauze, and finally the shape of the nozzle shown causes eddies in the flow, which are of still further assistance in the same direction. Of course, there is no new feature in any one of these points taken separately, and the fact on which I lay emphasis is that all these methods are combined and the proportions adjusted to secure the most intimate admixture possible between the gas and the air before they enter the furnace.

One point has been provided for in this burner that is not always sufficiently considered. Of the total amount of air required for the combustion of the gas only a small proportion is supplied under pressure because more than half the air which is used is drawn through the adjustable opening provided for that purpose, and this auxiliary air supply, of course, leads to considerable economy in working. It is customary for users to inquire about the gas supply and to ignore the fact that compressed air also costs money. In the mixing chamber that is used on these furnaces the consumption of compressed air is reduced to less than half of what is frequently required for a similar purpose.

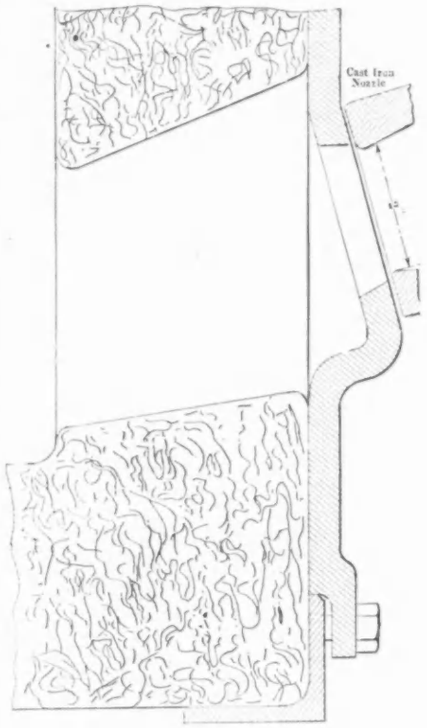


FIG. 4. INLET USED FOR GAS

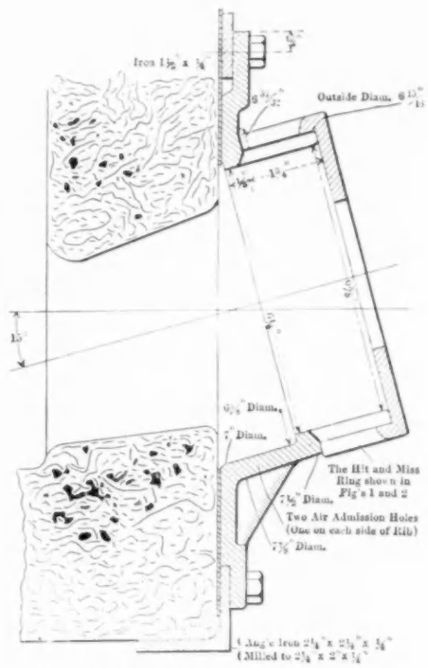

Iron 1½" x ¾"
Outside Diam. 6 15/16"
The Hit and Miss Ring shown in Fig's 1 and 2
Two Air Admission Holes (One on each side of Rib)
4 Ang'e Iron 2¼" x 2¼" x ¼" (Milled to 2⅛" x 2" x ¼")

FIG. 5. SECTIONAL VIEW OF OIL AND AIR INLET

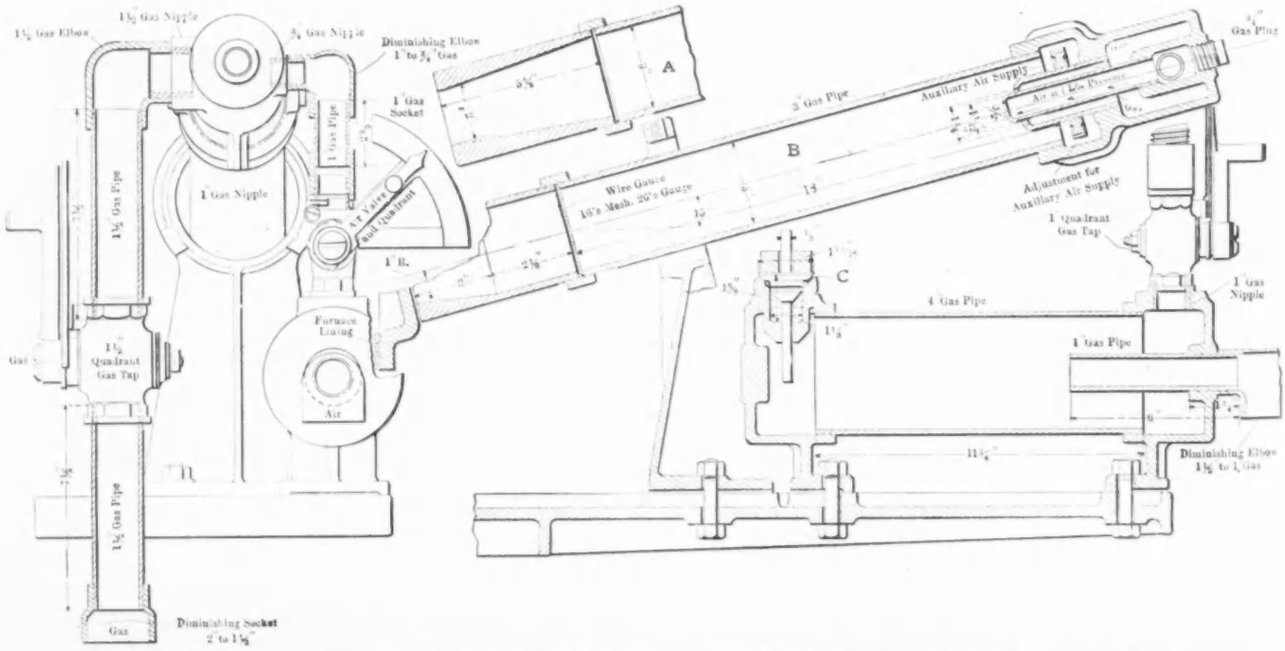


FIG. 3. SECTIONAL VIEW OF MIXING CHAMBER, BURNER AND GAS CONNECTIONS AT THE RIGHT OF FURNACE IN FIG. 1

The blow-off valve which is shown at C, Fig. 3, has a double seating, the lower one of which has a fine taper. By this arrangement the valve is exceedingly steady in its action, and when it is passing air it will float in any position without any tendency to jump; indeed, anyone looking at the valve in action might easily suppose that it was stuck in that position so steadily does it adhere to the hight necessary to accommodate the air passing through, and if an extra quantity of air is suddenly supplied to the air chamber the valve simply lifts a little higher and remains stationary in its new position.

The opening into the side of the furnace and the casting which is bolted over it to form the inlet for gas, when gas is used for the fuel, is shown in Fig. 4. The gas nozzle *B* in Fig. 3, is located close to this inlet as shown.

Importance of Correct Gas and Air Mixture

In a former paragraph I spoke of the importance, in the case of high-speed furnaces, of paying very particular attention to the admixture of the gas and the air before they enter the furnace and herewith explain this point further. In the first place, I think it very desirable, when hardening high-speed steel, to work in the open furnace without a muffle because my experiments have led to the conclusion that by so doing the work can be done much more economically and also a better result produced, and at the right time I shall be prepared to defend the position that I have taken upon this point. But if the work is to be done in the open furnace in which the combustion takes place it is essential that certain precautions should be observed, as if they are neglected the mistake will be fatal.

It is well known that an oxidizing atmosphere is injurious even when ordinary carbon steel is being treated, but the action is strongly intensified in the case of high-speed steel because of the much higher temperature to which it is raised. Indeed, in this latter case a reducing atmosphere is essential to success.

For the formation of a neutral atmosphere it is necessary to admit enough gas to combine with all the oxygen that is admitted with it, and any excess of gas beyond this should go to make the atmosphere reducing; but, as a matter of fact, a mere excess of gas may fail to prevent an oxidizing action. Indeed, it is possible to have a very great and wasteful excess of gas and at the same time have the surface of the steel burnt and destroyed. The explanation of this is that the vital question is not simply whether the gas is in excess, but whether it is so intimately mixed with the air before it enters the furnace that the oxygen of the air is unable to attack the steel. If the admixture of gas and air is sufficiently complete a very slight excess of gas makes the atmosphere effectively reducing because, if the expression may be allowed, the whole of the oxygen is already earmarked by the gas and it will unite with the gas in preference to the steel, whereas imperfect admixture leaves the oxygen momentarily free to attack the steel.

I have seen furnaces for high-speed steel in which the jet discharged directly into the furnace without passing through a mixing chamber at all, and it was explained to me that this was a very valuable feature because "lighting back" was impossible, but I was not surprised when I heard complaints about the furnace, and the users of it told me that all high-speed work should be done in a muffle and kept away from the flame or the products of combustion. The fact was that they had failed to spot the real cause of the trouble, and in trying to avoid one difficulty they were going to introduce another. The cure consists in insuring not merely what is commonly called a reducing atmosphere, but an atmosphere which is *effectively* reducing.

FIG. 7. TESTS OF MILLING CUTTER

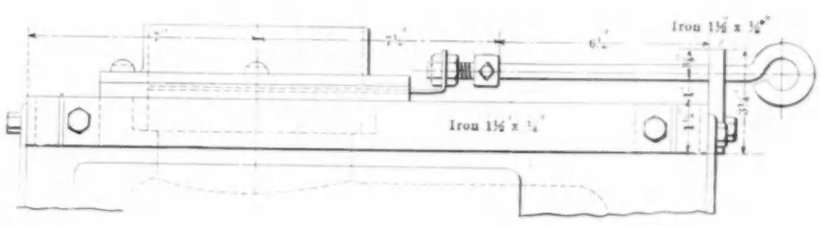


FIG. 6. DAMPER ARRANGEMENT FOR OIL AND GAS FURNACE

Oil Vaporizer

When oil is used in an open furnace for hardening high-speed steel it is impossible to produce good work if the oil is burnt on the principle of atomizing and blowing it direct into the furnace. On the atomizing principle it is, of course, easy to obtain the heat required and also to supply an excess of fuel, but the atmosphere is not effectively reducing. The only satisfactory way is to have the oil properly vaporized, heated to a high temperature, and thoroughly mixed with the air before it enters the furnace.

On the furnace in Fig. 2 the vaporizer which is used is shown. The liquid oil at a pressure not exceeding 25 pounds per square inch is supplied to this self-acting vaporizer, from whence it is discharged as a jet of highly heated vapor. Arrangements are made for securing a good admixture with the air, and the mixture passes through the inlet shown in Fig. 5. This inlet is arranged with a hit-and-miss ring, by means of which any additional supply of air may be regulated as required.

The damper is the same in both the gas and oil furnaces. A rod with a ring in its end is shown on top of the furnaces in Figs. 1 and 2, and with this the damper in the pipe is moved out and in. The damper arrangement in detail is shown in Fig. 6.

For ordinary work pyrometers are not used on these high-speed furnaces; the man simply works with colored spectacles, which, under suitable conditions, are all that is required, but I may say that for scientific work various kinds of pyrometers, including the Fery, are used.

Some Tests of Work Hardened in These Furnaces

Having now dealt with the furnace, there is a cognate subject to them. Much of my work is of a professional character in the way of testing steel, reporting upon hardening difficulties and so forth. One of my principal claims is that I can harden any number of cutters made from the same steel and get the same work from every one of them. The results which I give are not obtained from a tool which has been selected out of a batch by trial.

One of my customers recently sent me

some high-speed steel to be made into milling cutters, which I was then to test and report upon. These milling cutters were hardened by thoroughly heating in the upper chamber, which is kept at a bright red; then transferring them to the lower chamber in which they are frequently moved about and turned over, until thoroughly soaked in the very high temperature required for the best results, which is usually 1200 degrees Centigrade or 2200 degrees Fahrenheit. Then the cutters are taken out and immersed in a salt bath that is maintained at a temperature of 690 degrees Centigrade, or 1275 degrees Fahrenheit. They are stirred vigorously in this bath until they cool to the dull red of the bath, after which they are taken out and allowed to cool off in the air. This gave them an intense hardness to a good depth and there was no tendency to softness when the cutters were ground down.

The cutters were 2½ inches diameter, ½ inch thick, ⅞ inch hole, H. & R. Waterfall & Barber's high-speed steel, and were tested by cutting ordinary carbon tool steel for milling cutters at 200 revolutions per minute with a cutting speed of 131 feet per minute. The result of the tests was as follows:

No. of Trial.	Number of Continuous Cuts Each 16½ Inches Long.	Depth of Cut.	Width of Cut.	Feed per Minute.
1	1	½-inch	⅛-inch.	6 inches.
2	1	⅛ "	⅛ "	7½ "
3	1	¼ "	⅛ "	9½ "
4	1	¼ "	⅛ "	12 "
5	1	¼ "	⅛ "	15 "
6	3	¼ "	⅛ "	18½ "
7	16	.05 "	⅛ "	18½ "

During the above trials the cutter was cooled with a good flood of water. The surface left on the work was of a bright, smooth finish and at the conclusion of the tests the cutter was in good condition for further work before regrinding.

Tests by Cutting Cast Iron

Further tests were carried on in cast iron. The milling cutter and cast-iron bar that was cut are shown in their exact size and shape while cutting in Fig. 7. The results of these tests are as follows:

	Test No. 1	Test No. 2.	Test No. 3.
Revolutions per minute.	200	200	290
Cutting speed per minute.	131 ft.	131 ft.	190 ft.
Feed per minute	12 in	52 in.	78 in.
Number of cuts	16	4	12
Length of each cut	6 in.	6 in.	6 in.
Condition of cutting	Dry	Flooded with water	Flooded with water
Condition of cutter	No wear, used for 2d test without grinding	No wear, used for 3d test without grinding	Cutting well, but dulled; needed grinding

I should like to point out with regard to test No. 1, that although it only shows a feed of 12 inches per minute yet it is an exceedingly severe test because the sharp corners of the angular cutter are taking a cut more than a quarter of an inch deep, as you will see from Fig. 7, and the points showed no signs of wear from beginning to end.

Respecting No. 2 test, I think much better results could be obtained with this cutter under certain circumstances. When these tests were made I began running at a cutting speed of 131 feet per minute; now at this cutting speed the fastest feed that I could give was 52 inches per minute, which was not fast enough to make any impression on the cutter. In order to increase the feed per minute I was forced to increase the cutting speed as well, although I did not want to do so.

In the third test I was running at a cutting speed of 190 feet per minute and a feed of 78 inches per minute, but the cutter began to show signs of wear. Now, I believe that if the cutting speed could be kept at 131 feet per minute and given a feed of 78 inches per minute the cutter would have done the work easily without requiring regrinding until it had been running for a very long time.

Before the trials the teeth of the cutter were ground low as though it had been resharpened several times. This was to increase the severity of the test, because it is often found that high-speed cutters deteriorate rapidly after the first two or three regrindings. The cutter was very hard after the third test and easily scratched glass. This is how all cutters should be, and although some cutters which are filable do good work, they would do very much better if they had been properly hardened.

Patterns for Twin Locomotive Cylinders

By C. Patton

The making of pattern and core boxes for a pair of locomotive cylinders is a somewhat difficult job, as will be acknowledged by those who have had anything to do with either the designing or making of them. This is especially true of some of the cylinders that have been made for the modern types of locomotives where the smoke-box saddle has been made to form part of the casting.

As regards the design of the different types of cylinders, it may be taken for granted that the principles involved in the making of patterns and core boxes, are, generally speaking, applicable to most, if not all, classes, core boxes for piston valves excepted. It will therefore be sufficient for the purpose if one of comparatively simple design is taken for example.

The one shown in Figs. 1, 2 and 3 may be taken as typical of British design for *D*, or balanced slide valves arranged for Joy's valve motion.

The number of castings required will determine the quality of labor and material to be used; if 30 are wanted for the first order with the probability that more will be required, it leaves no doubt that both labor and material must be of the best. More than 100 castings have been made from patterns built up on the lines which will be explained in this article, and with a few repairs to pattern and core

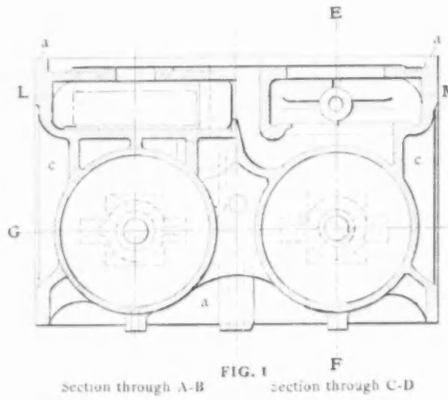


FIG. 1
Section through A-B Section through C-D

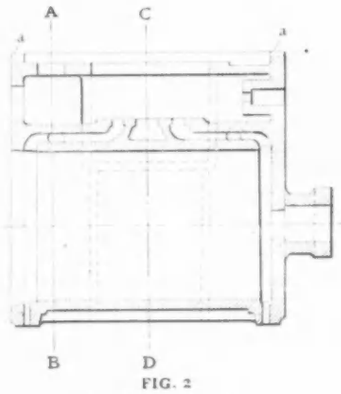


FIG. 2
Section through E-F

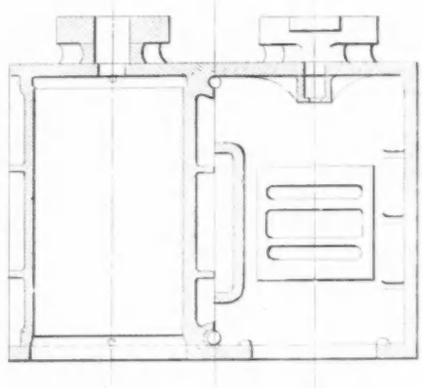


FIG. 3
Section through G-H Section through L-M

THE CYLINDERS TO BE MOLDED

boxes they will be good for another 50, proving that it pays to make a good job when such is required.

A full size layout of Figs. 1 and 2, preferably on separate boards, is necessary, and it is advisable to have these checked over before proceeding with the work. It will be found true economy to use the best lumber throughout; battens and stiffening pieces excepted, but even these should be dry.

Fig. 4 shows method of building the top half of pattern; this will be the bottom when molding. The joint face is made out of broad deal lumber 3 inches thick, feather-jointed, and with cross-battens of bay wood at each end. The ends are recessed to take the sides, and both ends and sides are recessed round the top to suit thickness of flanges *a*, Figs. 1 and 2. This recess also acts as a shoulder for the top to rest on.

The ends are also carried down to the joint face, Fig. 5; this prevents the overlapping which might take place through shrinkage if the timber forming the joint face should not be sufficiently seasoned.

After securing the sides and ends to the face, two stays are fastened across as shown *a a*, Fig. 4. A block is fixed between these to act as a stiffening piece to which the rapping plate *b*, Fig. 4, is screwed. Blocks are also put in for the lifting plates *d d*, Figs. 4 and 8. The top is now put on and made ready for the steam inlet, exhaust facings and prints. The prints are doweled on so that in case any making up is required they can be used for that purpose. The prints for side lightening cores *c c c*, Figs. 1 and 4, are made out of 3-inch deal as are also the prints for the barrel cores. These are made up of two thicknesses, glued and screwed onto the end of the pattern. The same with the stuffing boxes at the other end. The prints for this end are turned and bedded in the stuffing boxes and a portion of the body pattern. It is necessary to make a strong job of these as they are required to carry the lifting irons *e*, Fig. 8, which are used for convenience of handling the pattern.

The cross-section, Fig. 6, shows how the bottom half (top half when molding) is built up and requires no further explanation.

Figs. 7 and 8 show the completed pattern. The front steam-chest cover facings, with prints fastened to them *e e*, Fig. 7, are pinned on loose so that they can be drawn in after the pattern is taken out of the sand.

The core boxes are invariably made after the pattern. Steam-chest core may be made either whole, in one box, or as two separate cores which means two boxes, right and left hand; something may be said in favor of each way, but it may be taken generally that if the cylinders are small, a complete core is best, and if large the double ones will be preferred as the cores are not so liable to distortion when drying, and are easier handled and set in the mold. Fig. 9 shows the latter way, one-half of the top

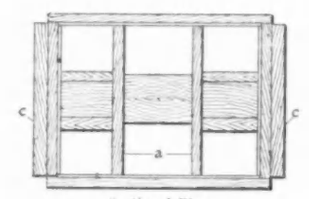


FIG. 4

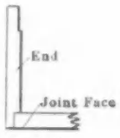


FIG. 5

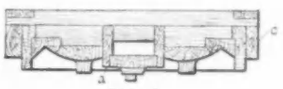


FIG. 6

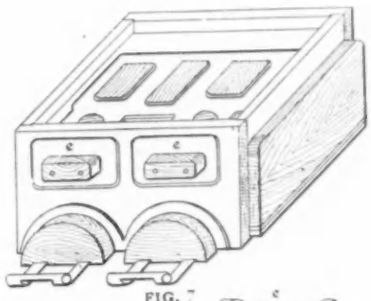


FIG. 7

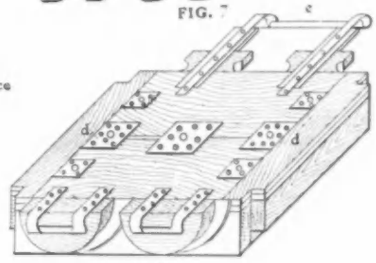


FIG. 8

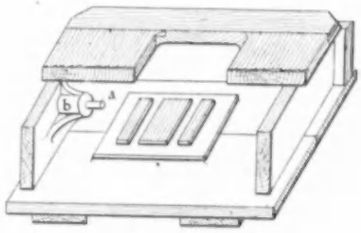


FIG. 9

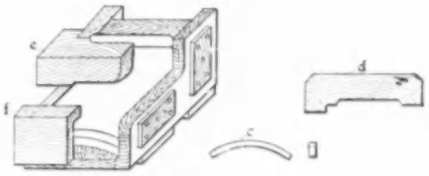


FIG. 10. Steam Ports

THE CORE BOXES, COMPLETE PATTERNS AND STEAM PORTS

FIG. 11

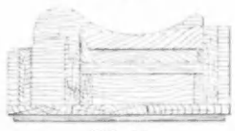


FIG. 12

FIG. 14

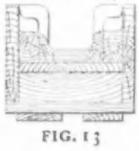


FIG. 13

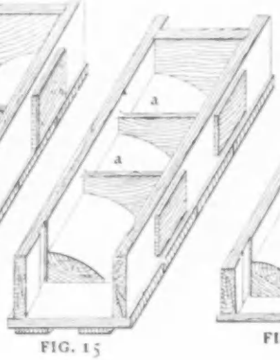


FIG. 15

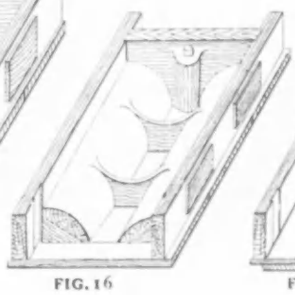


FIG. 16

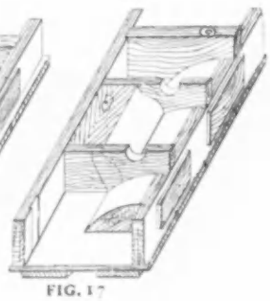


FIG. 17

EXHAUST CORES AND SIDE LIGHTENING CORES

and one side are removed to show more clearly the construction. The pin *a* is the print for the valve-spindle core, and is made so that it can be drawn from the outside through a hole of corresponding diameter bored through the end of the box and center of boss *b*. It also acts as a guide peg for the boss which should be loose.

Fig. 10 shows the steam-port box. Only one box is used and is made suitable for the opposite end by having a removable piece *c* which makes up for the larger diameter required at the inside end of cylinder. The "strickle" *d* is used to form the top of core between the pieces *e* and *f*.

Fig. 11 is the box for exhaust core which is considered the most difficult one to make. An elevation and cross-section of the box is shown in Figs. 12 and 13 to show how it is put together; two cores are required from this box. Of course a double box could be made to have the core in one piece, but the same remarks apply here as in the case of the steam-chest core, viz., ease of handling and setting.

The side lightening cores are made in a box constructed as shown, Fig. 14. Two cores are made out of this, one for each side of cylinder; the same remarks apply to box, Fig. 15, which is for the other half of pattern; in making these two boxes care must be taken to have the ribs *a a* in such a position that there will be no overlapping when they are brought together in the mold.

Fig. 16 is the box for the core which makes up the outside space between the cylinder barrels *a a*, Figs. 1 and 6. It is quite possible to do without this core by making the pattern the correct shape, but the molders prefer the core as it saves a lot of gagger fixing, and again, a much stronger pattern is possible. This core is fixed in the mold while both are green.

One-half of the inside center lightening box is shown, Fig. 17. This box, like the preceding ones, is shown with the end removed, and the frame made out of 2-inch lumber. Battens are fixed on all these boxes for rapping.

The other boxes required are, Fig. 18, which is a core for oblong opening into front of steam chest. Fig. 19, steam-chest drain core, and Fig. 20 small round core for steam inlet into top of steam chest. Two cores are required out of each box. The barrel and valve-spindle cores are made with the loam boards, Figs. 21 and 22, respectively. These boards are lined along the edges with 1½x1⅛-inch wrought-iron strips, which is found to be necessary owing to the quantity of cores required, otherwise the grinding action of the loam on the boards would very soon put them out of shape. Pieces *a a*, Figs. 21 and 22, are strips of wrought iron ¾x⅜ inch, screwed on the back edge and are used for setting the calipers to the diameters required.

The molding and setting of the cores might well form the subject of another article, but the sections shown in Fig. 23 will not be out of place here. Three molding boxes are used and the sections show the joints of the boxes and cores, and also the means taken to secure the cores in position.

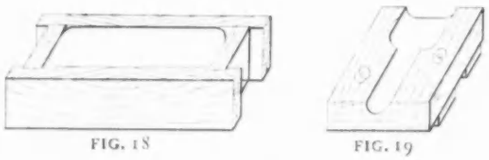


FIG. 18

FIG. 19

FIG. 20

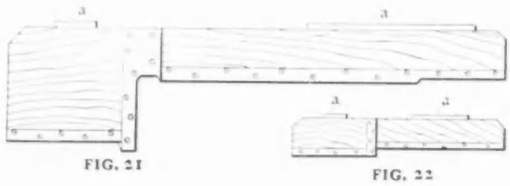
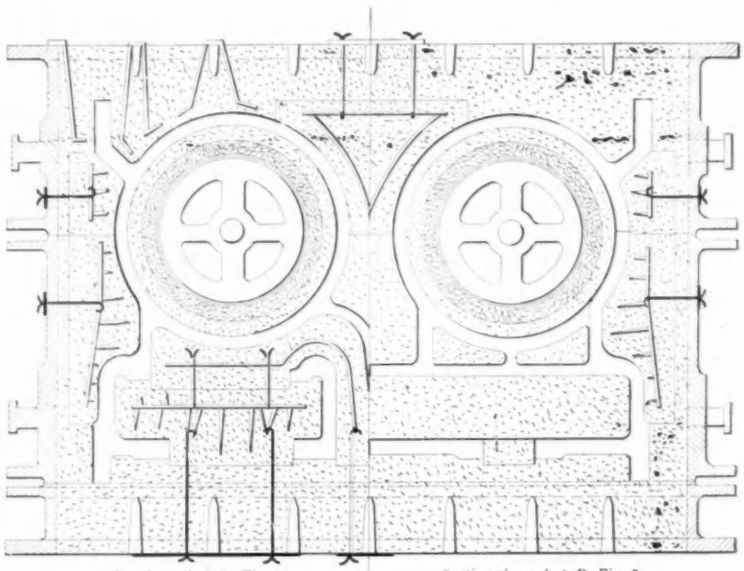


FIG. 21

FIG. 22



Section through C-D, Fig. 2 Section through A-B, Fig. 2

FIG. 23

CORE BOXES, LOAM BOARDS AND SECTION OF MOLDS

A flowing well from which both fresh and sulphur waters are obtained is said to be located in Logansport, Ind. The well was drilled two years ago and an 8-inch pipe sunk 80 feet, in the inside of which was placed a 5-inch casing. Fresh water from a bed of limestone comes up between the two pipes, while water which tastes and smells strongly of sulphur comes up through the 5-inch pipe from a lower portion of the limestone.

Some Vicissitudes of Any Shop

By J. B. Dornbirer

The foreman is usually envied and his position is coveted by those who think he has a snap. This condition keeps him on his mettle, and if he is not confident of his ability to hold his position and becomes irritable and suspicious, some ambitious citizen will soon qualify for his job. If he is late more than once in five years someone will use it as an excuse to come in late weekly; if he makes a mistake semi-annually he is in danger of losing his prestige. His conduct must be eminently correct toward the men over him and under him. He must be infallible if he wishes to escape criticism. He is usually expected to put into execution without a moment's notice any hallucination that any of his superiors may have.

In recent years a great many cost systems have been introduced but there is only one which is the best and, strange to say, everybody is applying it. There are some which are idiotic. They usually rob the foreman of his efficiency quicker than starvation, especially if some little unavoidable mistake is viewed through a 10,000-diameter magnifying cost system. A foreman must be careful how he gives orders to those who have it "in for him." He might tell someone to "line up that shaft perfectly straight" and the aforesaid someone might have studied up a little and would inquire for the value of the versed sine before complying with the conditions of the problem. Now, if it should happen that the foreman did not know the versed sine from a bean pole, but did know 101 things of infinitely more value, someone would think that he was a poor foreman.

Then again, if he gives an order and

for some good reason countermands it without making an elaborate explanation on the bulletin board, he will be accused of not knowing the business. I wish to make an apology for using the overworked word "countermand." I have heard it used so much in the past nine months that it was written without due thought and I did not wish to follow in the steps of others to countermand it.

Did you ever notice how nearly all of us think how nicely we would fit in the foreman's position, and in the next moment count up the men we would "fire" if we had the say? Perhaps each one of those men fill their positions admirably, but we simply don't happen to like them. That is enough to disqualify us for the job at once. If the foreman is a young man who got his job solely upon merit, more or less objection will be found because in the commercial world men are not selected for higher positions as they are in the army and navy. The scrap pile is an awfully expensive by-product which requires great care and forethought on the foreman's part to keep down without selling it off weekly. Frequently he has some men to deal with who have more pride in "doctoring" their own mistakes than in knowing how to do good work; such misdirected ability must be piloted into the proper channel.

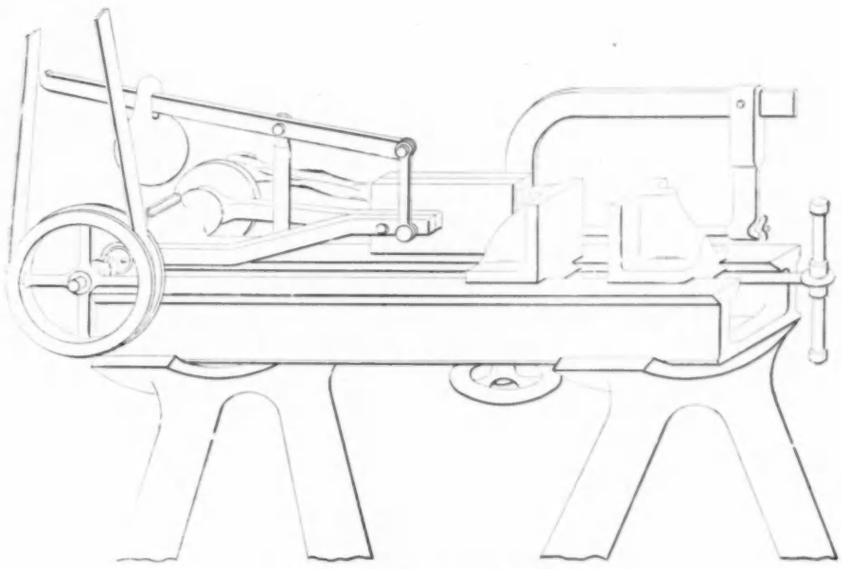
Justice and equality must not be sliced off with a hatchet; that must be done with the same precision that is desired mechanically. After a foreman has mastered the work in his charge and has settled on the best and most expedient methods, some new man begins to experiment on some other way and has the temerity to remark that there is "more than one way to skin a cat." Under such conditions a foreman must be able to say in a firm and decisive manner, that we are not skinning cats but building machinery by the best methods our facilities afford. When times are good and good men are hard to get the foreman is worth every cent he gets, trading stamps included. I would respectfully request the proprietor and the machinery merchants to bear in mind that those who produce and oversee the production of an article can't reach up on a shelf and hand down a machine the same as one can get an ultimatum.

A foreman must see everything that is going on in his department; must know when to shut his eye and when to "sit up and take notice;" must be able to draw the line between discipline and nagging. Right here is the place to remark that not every first-class mechanic can make a successful foreman; and not every foreman needs to be a first-class mechanic. He must, however, be able to recognize good work without the formality of an introduction. True economy must be practiced in everything. Files are cheaper than mechanical skill. If a man brings you an old file to be exchanged for a new one, don't size it up with the remark that it was all right when his grandfather used it. If the foreman gets fired don't take it for granted that he was "no good;" notice how long the next broom lasts. Some proprietors can't get along with their "next of kin" let alone a good conscientious foreman. Now, "How would you like to be the foreman?"

A Rigid Homemade Hack Saw

By S. C. McKeown

The writer had the pleasure not long ago of examining a power hack saw that had been made out of junk and yet was as complete a machine for the purpose as he had ever seen. An old sawmill head-block bolted down on two cast-iron legs that had been used on a skid-mounted boiler, served as the shear while the knee of this and one borrowed from another head-block, cut off and planed, formed a vise with an old carpenter's vise screw to clamp them together. A clever little idea was taken advantage of here in having both jaws of the vise adjustable, that is, it was clamped down by a hand-wheel nut underneath the shear, and the whole vise could be moved one way or the other in order to utilize unused places in the saw. Thus if you had a long saw and were sawing small diameter stuff, you could use up all of your saw.



A RIGID HOMEMADE HACK SAW

How It was Made

The saw frame was forged of a piece of tire steel and shaped as shown in the drawing. The adjustable piece of the frame was secured from slipping by a pin as shown, holes being drilled at the proper intervals to accommodate different lengths of saws ranging from 8 to 18 inches. The tension screw lay flush in the frame, thus allowing the use of the usual clamps to aline the saw. The frame proper was bolted to an old slide rest of a lathe as shown, this being bolted in turn to arms that diverged and extended back to a piece of 1½-inch gas pipe, on which they hinged. This pipe cradled in an old shaft box which was bolted down to the shear.

The crank-shaft consisted of an old pump flange keyed and riveted on to a turned shaft, this shaft being babbitted through the center of the pipe. A half clutch from an old gin feeder was next secured on shaft by a taper pin. Then the regulation gin feeder drive pulley with its clutch was fitted to run loosely on shaft until brought into engagement by a lever working in the usual slot. This lever is not shown in drawing. Wrist-pins for the crank and saw frame were next put in and a hickory connecting-rod put on with washers and cotters.

A Counterbalance and Clutch Trip

Thus, the machine was complete except for the fact that, on account of the extra weight of the parts, a counter-balance was necessary, and one that could be variable. For this purpose a standard was secured to the shear and a walking beam mounted thereon, one end being connected by a pitman to the non-reciprocating part of the frame and the other carrying an ancient safety-valve weight, the sliding of which varied the pressure on the saw.

A trip for throwing out the clutch was located on the clutch lever, being simply an arm projecting out in such proximity to the reciprocating slide that, on the saw's dropping through the work, said slide would throw out the lever. Having trip to raise saw out of the work was objected to on account of breaking saws. The work of this saw was above the average, being entirely free from the trembling so common in a great many manufactured machines.

Some Interesting German Machine Tools

Germans Are Called Copyists—Several of These Tools Show Originality of Design and Do Not Follow American Ideas

BY J. W. CARREL

A study of German machine tools has shown me that the statement that in regard to machine-tool design the Germans are mere copyists, while it might have been true a few years ago, is by no means true today. They exhibit originality in many ways as a consideration of the designs shown in this article will demonstrate.

A Double-spiral Milling Machine for Twist Drills

The accompanying half-tone illustrations, Figs. 1 and 2, show a twist-drill milling machine built by Biernatzki & Co., Chemnitz, Germany. Its capacity is for drills from about 7/16 of an inch in diameter to 4 inches in diameter, and of any length up to about 3 feet. The working parts are carried on a heavy box bed, as shown. Each cutter head is driven from a 4-step cone, from which motion is transmitted by means of a spiral gear. These gears are all cut from the solid. All of the working spindles and shafts are hardened and ground on the journals. The feed is automatic, is driven directly from the countershaft, and is controlled either by hand or by adjustable stops. The eight feeds, which are, of course, in millimeters per minute, expressed in approximate inch dimensions, are: 0.2, 0.3, 0.4, 0.6, 0.8, 1.2, 1.7, and 2.4 inches per minute.

In order to hold the drill rigidly during the cut it is passed through a bushing held close to the cutters. These bushings are exchangeable to adapt to machines for various sizes of drills. The drills can be cut with either a right-hand or left-hand spiral, as desired. There is also an arrangement whereby the flute can be cut straight for a short distance from the point and then can be continued with an increasing spirality as is common in drills made in this country. The drive of the machine has sufficient power so that a 2-inch drill can be finished at one cut, and a drill about 1½ inches in diameter can be completely finished in 14 minutes with one cut.

A Radial Drill Having Two Spindles

This radial drill, Fig. 3, which is made by the Deutsche Werkzeugmaschinen-Fabrik, Donderman & Stier, Chemnitz, Germany, has two spindles; the one is for drilling, as ordinary radial drill work, the other is provided with a special tapping attachment. The drill is provided with a double disengaging gear, a counterbalanced spindle with a momentary release and a quick-return motion. The feed-screw rotates in hardened-steel nuts and is operated by means of a worm and worm-wheel. The radial arm can be raised and lowered by power. The capacity for drilling is up to about 5½ inches in diameter and 13 inches deep. The spindle diameter is about 2¾ inches. The maximum radius of the arc that the spindle can describe is about 80 inches. The maximum distance between the spindles and platen is about 100 inches. The independent tapping attachment can tap holes up to 2 inches in diameter. Micrometer graduations on a hand wheel permit the moving of the tapping head so that the tapping spindle will register exactly with the previous position of the drilling spindle.

Automatic Gear-hobbing Machine

The three half-tone illustrations, Figs. 4, 5 and 6, show an automatic gear-hobbing machine which is made in two sizes by Biernatzki & Co., of Chemnitz. These illustrations show three views, front, rear and the operating mechanism on the head end. The bed and stanchion are in the form of a single box-sectioned casting; the space in both base and the rear of the stanchion is arranged for storage of change gears and thus parallels several American designs. Power is received on a four-step cone shown on the rear of the machine. The cutter head and work-spindle head are connected by means of gearing, so that while their motions are independent their movements are correlated and adapted to the gear being cut. The cutter slide is driven by a feed-screw connected directly with the large worm-wheel by means of bevel gears.

This type of machine is built for cutting spur, spiral or worm-gears. There are two sizes known as 1*U* and 2*U*. For the 1*U* size the diameter limits for spur gears are 1¼ inches and 27 inches. The minimum diameter limit for spiral gears up to 45 degrees spirality is 2 inches. The maximum face of spur gears is 11¾ inches; the maximum face of spiral gears of 45 degrees spirality is 7⅞ inches. The maximum pitch limit for spur gears of cast iron is 3½ diametral pitch, for spur gears in steel 4½ diametral pitch, for spiral gears of 45 degrees spirality of cast iron

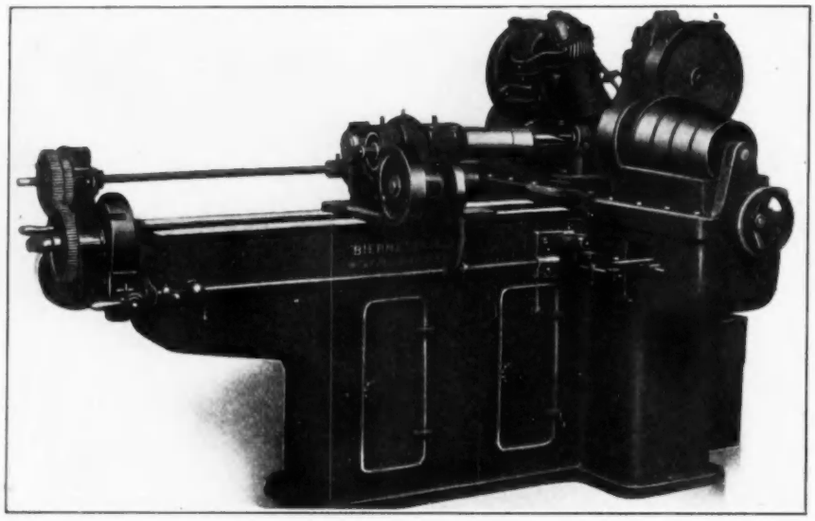


FIG. 1 A TWIST-DRILL MILLING MACHINE

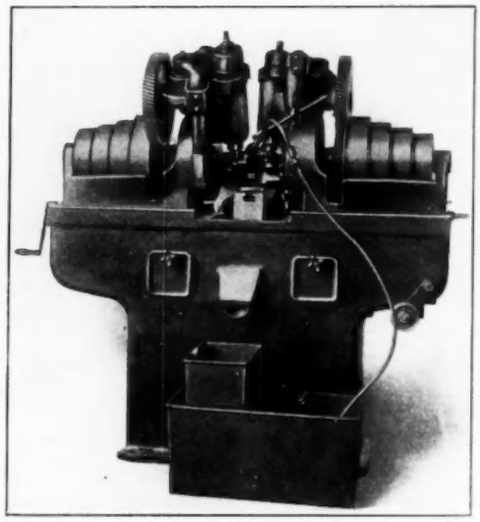


FIG. 2

4½ diametral pitch and for spiral gears of 45 degrees spirality in steel 5 diametral pitch. The various limits for the *2U* size are the same as for the *1U* size, with the exception of the maximum diameter which is 39 inches.

A Small Automatic Gear-hobbing Machine

The accompanying half-tone illustration, Fig. 7, shows a small gear-hobbing machine for spur and worm-gears made by Biernatzki & Co., of Chemnitz. It is designated by them as their No. 0 machine and has a capacity of diameters within the limits of ¾ of an inch and 15¾ inches. The maximum width of face which can be cut is 11¾ inches. In cast iron the largest pitch which can be cut with one passage of the cutter is 3½ diametral pitch. In steel the similar limit is 4½ diametral pitch.

The general features of the design are the same as of other machine tools made by this firm. All of the working spindles are cast steel ground on the journals and running in phosphor-bronze bearings. In many places steel parts have been substituted where cast-iron parts existed in former designs. The cutter-head has an especially long bearing on the bed in order to eliminate as far as possible the element of vibration. The bearing of the cutter spindle has a lateral adjustment by means of a hand wheel and screw. A steel gage is provided for adjusting the hob exactly under the middle of the work. The working spindle is adjusted by means of a hand wheel and screw. The thrust of this elevating screw is taken on ball bearings. This adjustment is indicated by means of a graduated dial divided to 1/10 of a millimeter. There are 12 changes of cutter feed obtained by means of a gear box driven by a Renold silent chain and operated through a system of hand levers. An especial feature is the outward support for the work-spindle arbor. This is arranged for clamping by means of a

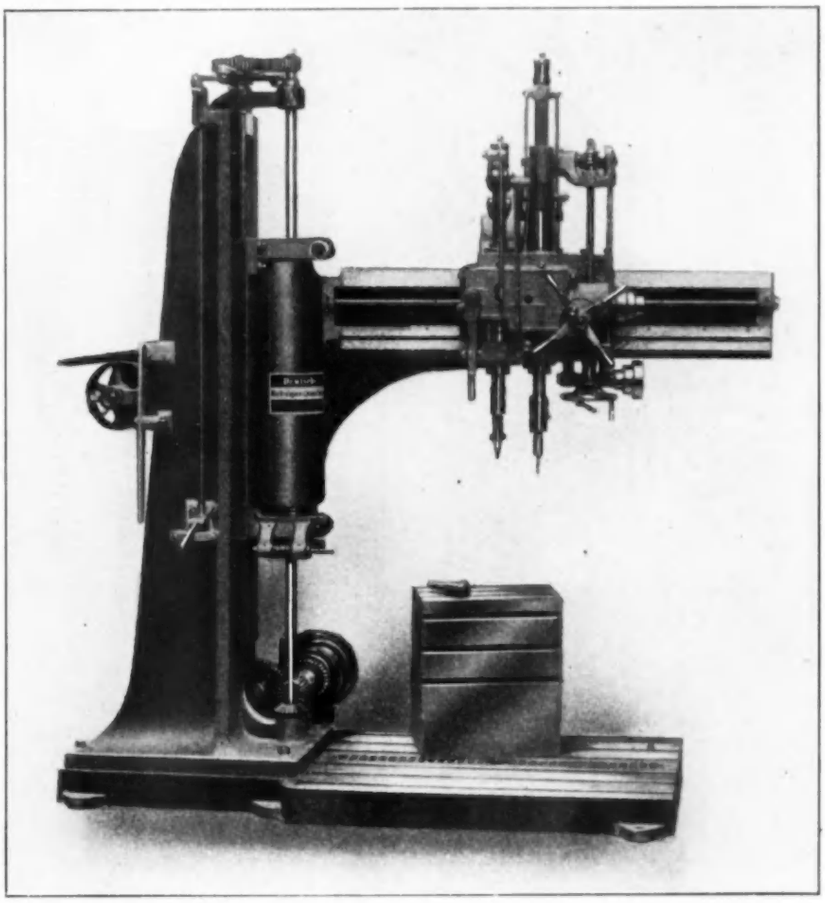


FIG. 3. A RADIAL DRILL WITH TWO SPINDLES

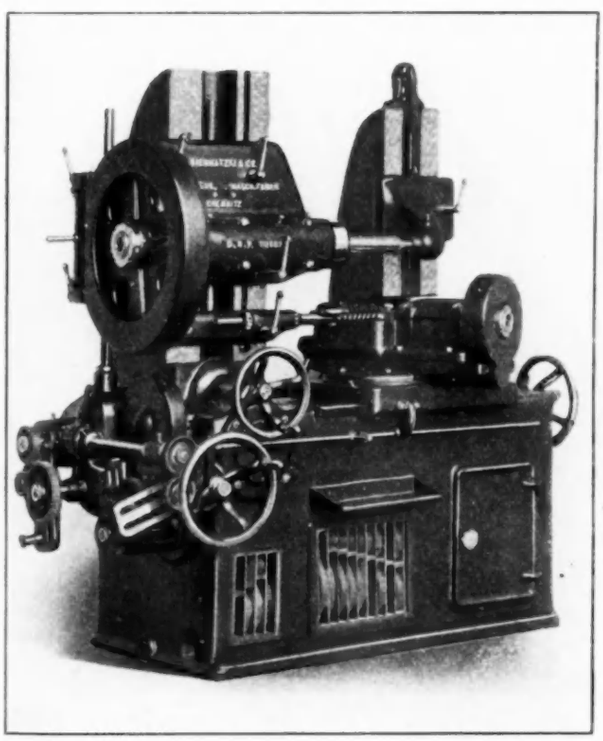


FIG. 4

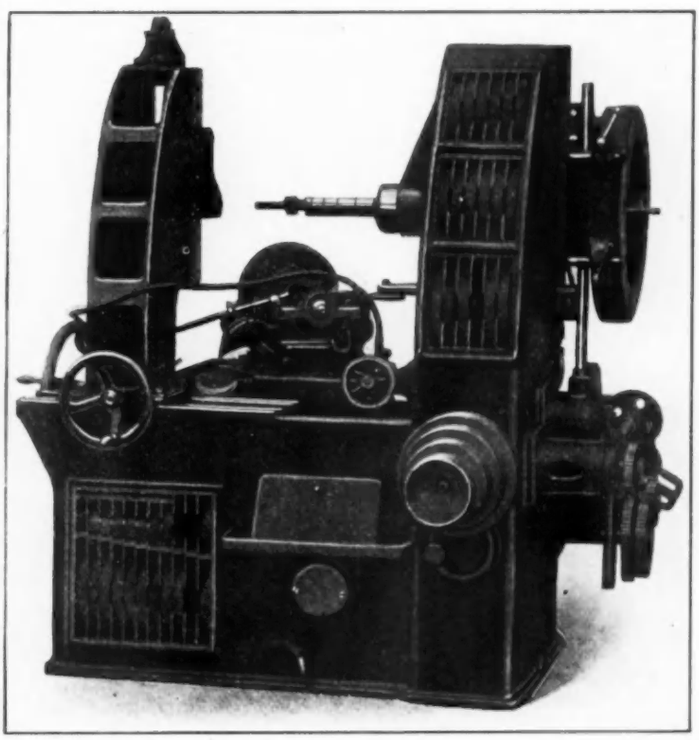


FIG. 5

SIDE VIEWS OF AUTOMATIC HOBBING MACHINE

single lever and is designed to give an extremely rigid support. Great care has been taken throughout the design of this machine to have all of the operating handles arranged on the front in a position which makes them easily accessible to the operator.

An Open-side Planer

An open-side planer of a design differing from any built in the United States is manufactured by the Hallesche, Werkzeugmaschinen-Fabrik, E. Meinel, Halle, a. Saale. It is built in four sizes of which the inside housing dimensions are, 36x32 inches, 40x36 inches, 56x44 inches, and 60x56 inches; they are referred to as models *SF*, *SG*, *SD* and *SE*, respectively. The models *SF* and *SG* are made with platens from about 6 to 15 feet in length; model *SD* from 8 to 20 feet, and model *SE* from 10 to 20 feet. Fig. 8 illustrates a machine of the *SE* type. The distinguishing feature is the large cylindrical column or upright. The bed is of the usual box-shape construction and the table is described as very heavy and rigid. The feeding motions in both a horizontal and vertical direction are power driven. The drive is by means of the usual open-end crossed belts and the pulleys are placed behind the column. Care has been taken in the design to concentrate all of the operating handles around the base of the column. If desired, any of these machines can be equipped with a motor drive in place of mechanical drive illustrated.

An All-geared Head Lathe

The illustration, Fig. 9, shows a good example of a German all-geared head lathe. It is the 1908 model of the Werkzeugmaschinen-Fabriken Herman und Alfred Escher, of Chemnitz. Several details are well shown by the illustration. It can be driven either from an overhead countershaft or from an electric motor, through the pulley shown at the rear of the headstock. It is arranged for a wide belt and is classed as a high-duty or high-speed lathe. There are sixteen cutting speeds, arranged in uniform steps from 5½ to 300 turns per minute. All of these steps are obtained through the operation

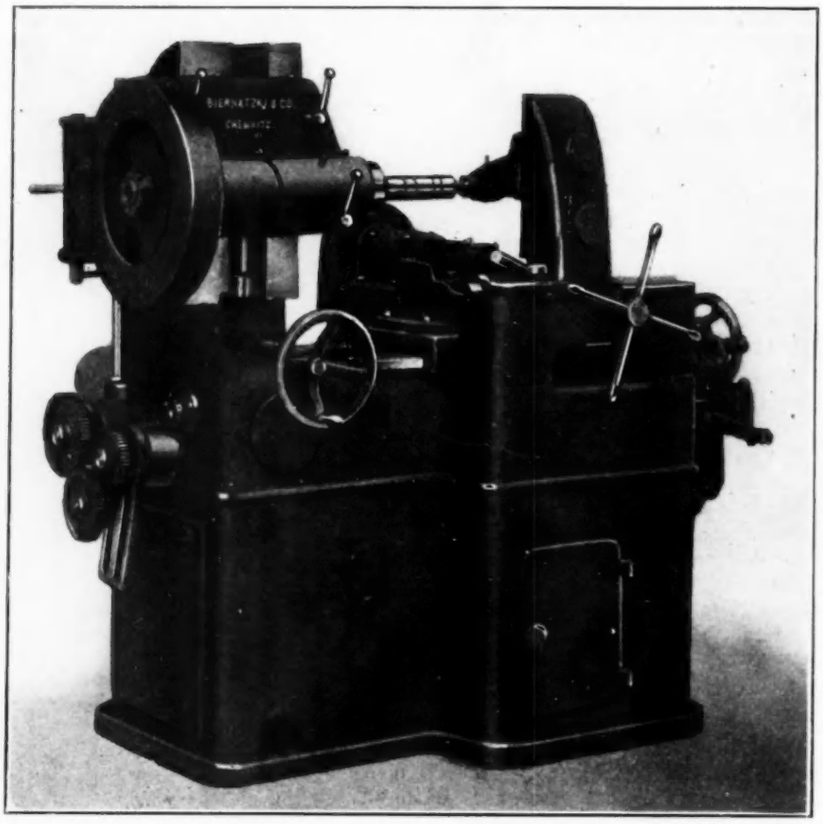


FIG. 7. A SMALL AUTOMATIC GEAR-HOBBING MACHINE

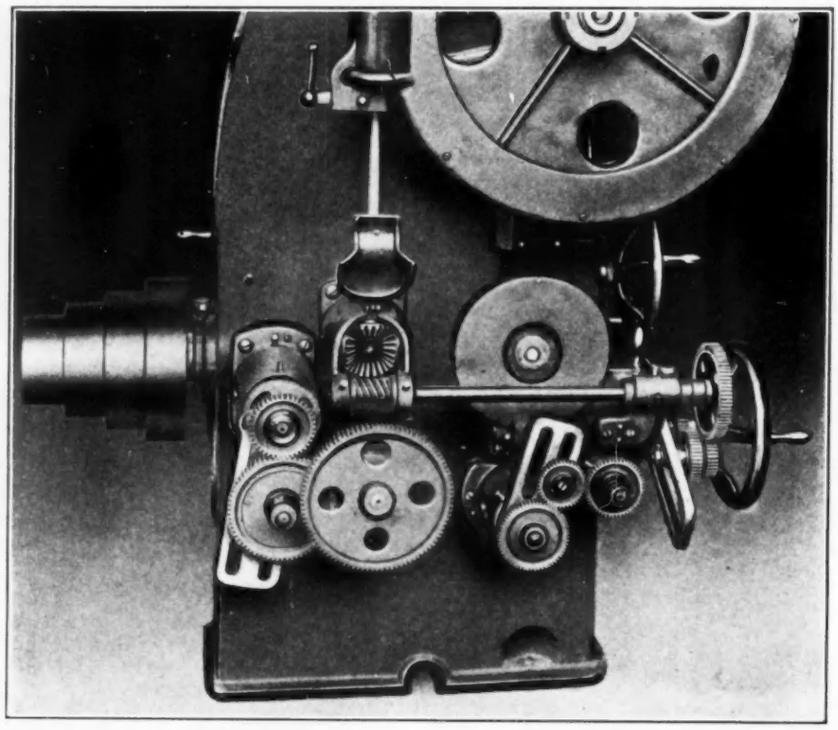


FIG. 8. END VIEW OF AUTOMATIC GEAR-HOBBING MACHINE

of two handles, which can be plainly seen by referring to the half-tone. One half of the gears in this headstock are of steel, and the other half of hard bronze. The carriage is arranged with broad, heavy ways, as shown, and there is a slight gap between the end of the ways and the headstock. The feed-shaft has six speeds obtained by means of a gear box which contains a nest of stepped gears. The changes are operated by means of the handle in front of the headstock and connected with the feed shaft. The lathe is arranged for screw-cutting either right-hand or left-hand and either Whitworth or metric thread.

A Horizontal Boring Mill

A good example of a German horizontal boring mill is from the Werkzeugmaschinen-Fabrik Union, of Chemnitz, and is illustrated by the half-tone, Fig. 10. The machine shown is arranged for motor drive; an extension base plate is arranged to support the motor and carry a part of a special countershaft. The machine is also made for a belt drive, in which case the headstock is provided with a four-step cone. The general lines are similar to Ameri-

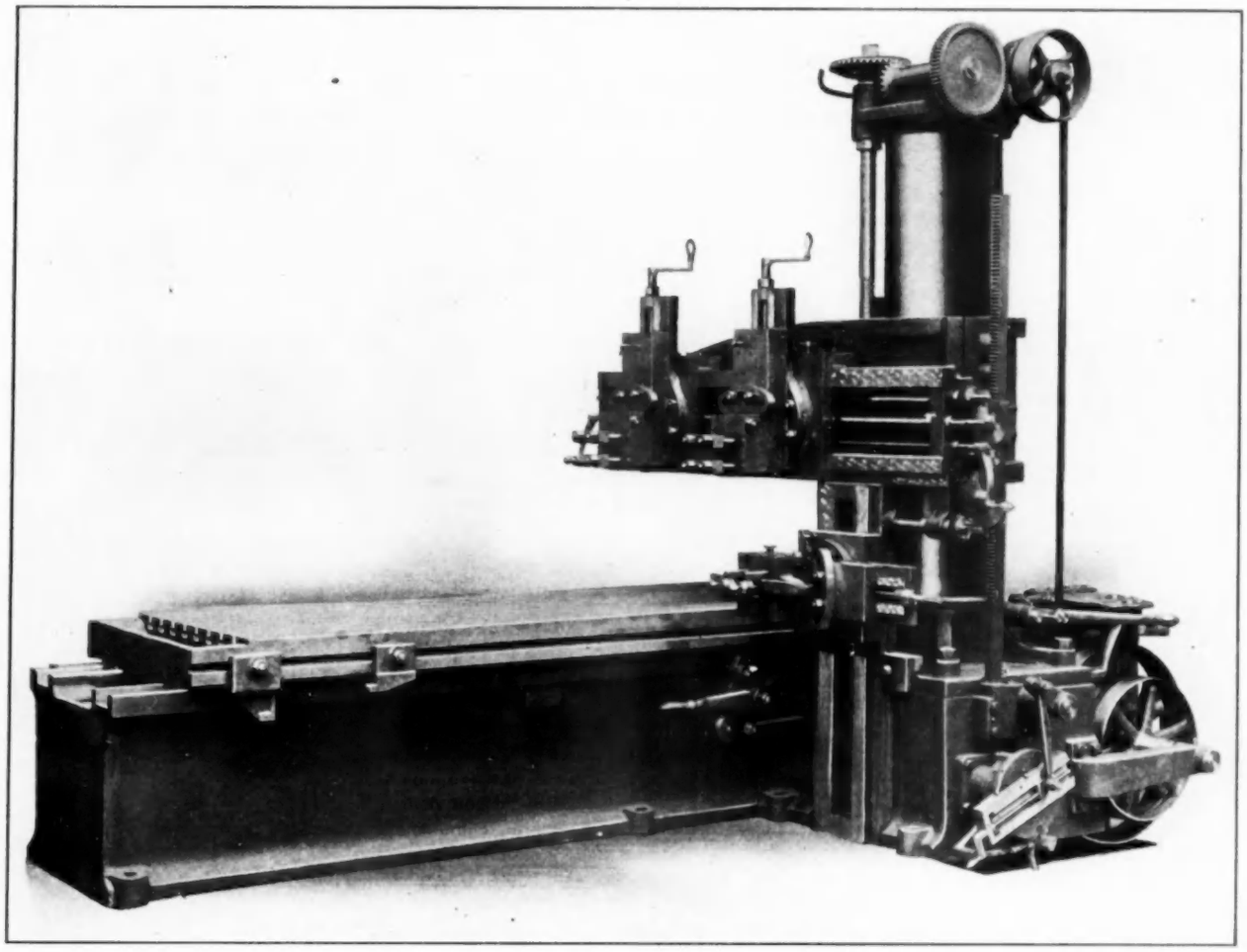


FIG. 8. AN OPEN-SIDE PLANER

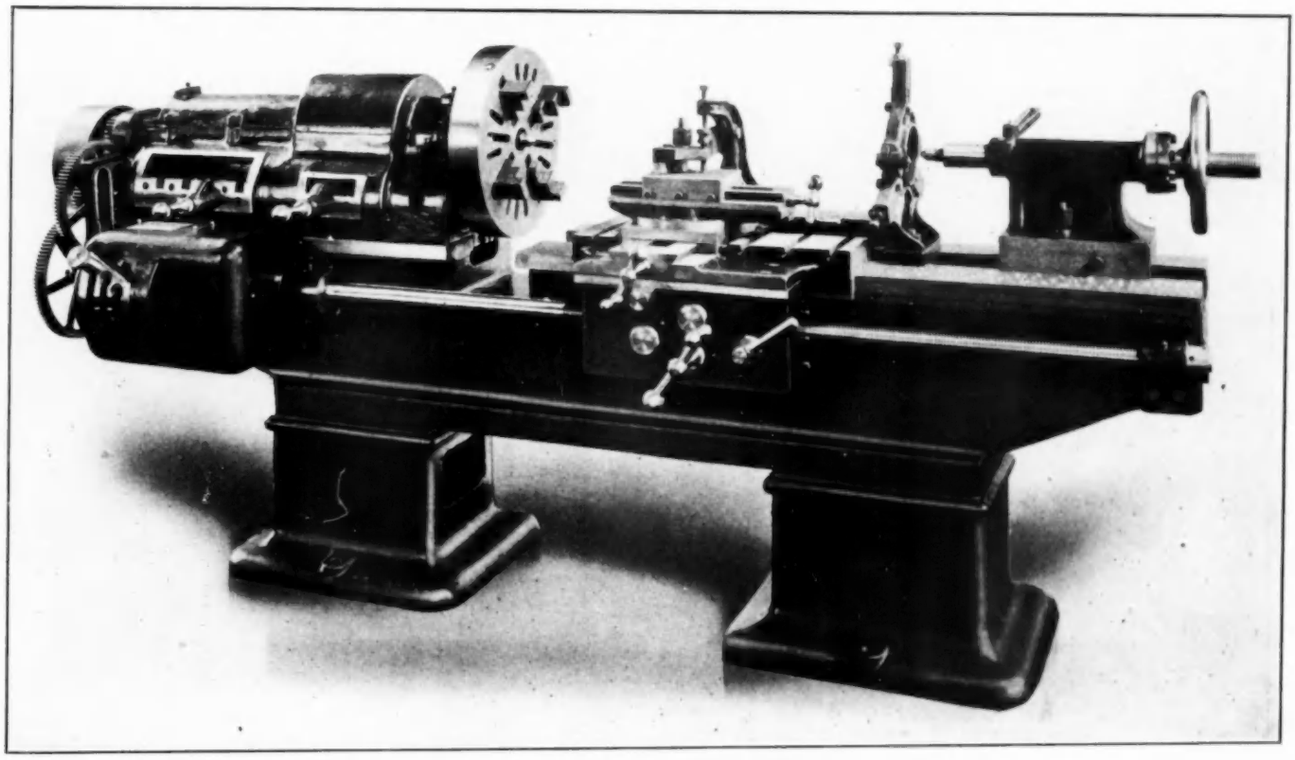


FIG. 9. A GEARED-HEAD LATHE

can practice; no detailed description is necessary.

A Special Lathe and Thread-milling Machine

An engine lathe adapted for ordinary lathe work and with a special attachment for milling threads seems a logical development and is exhibited by our illustration, Fig. 11. We regret that it is impossible to show a half-tone illustration of the finished machine. The tool was developed for shops which could not afford the expense of a thread-milling machine, but would, of course, have a variety of lathes for their regular work. The attachment which makes it possible to mill threads on this lathe is a special block designed to be mounted upon the cross-slide of the screw-cutting engine lathe. It is quickly and easily put in position or removed; thus very little time is taken to change over a lathe from ordinary lathe work to thread-milling machine work or *vice versa*.

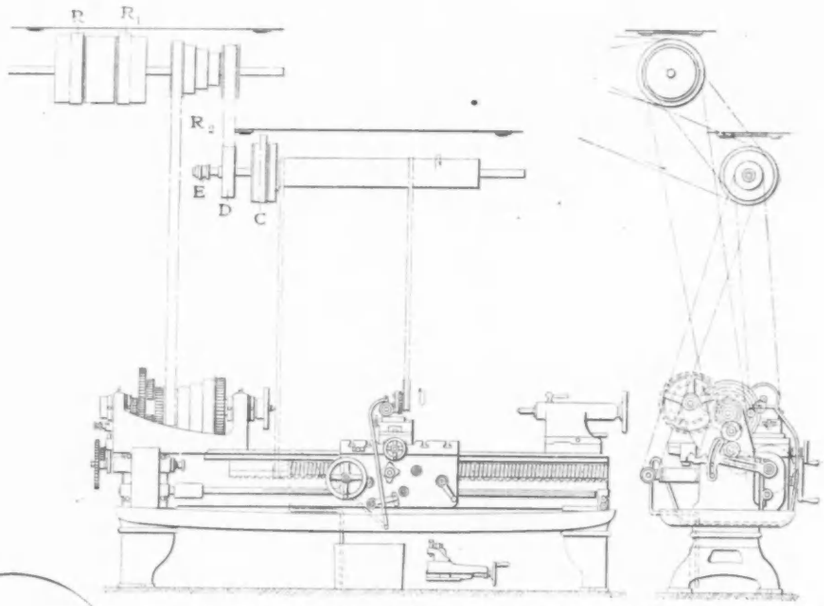


FIG. 11. COUNTERSHAFT AND METHOD OF DRIVING THREAD MILLING ATTACHMENT FOR THE LATHE

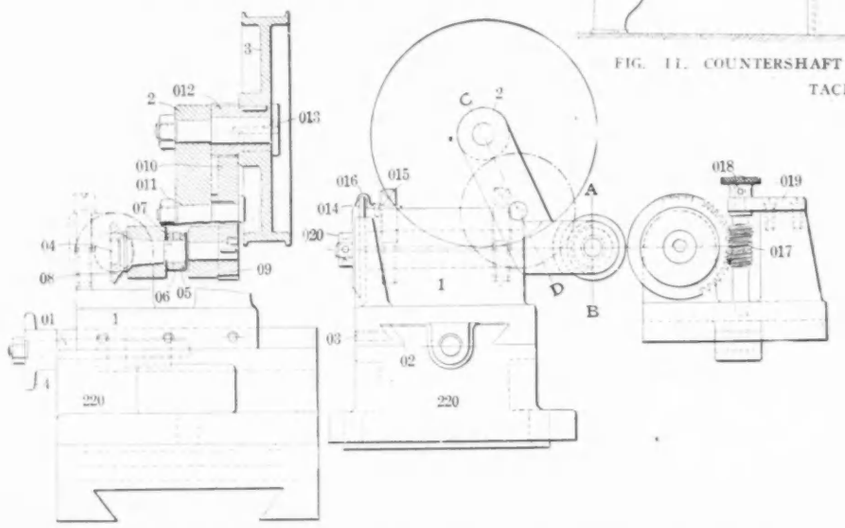


FIG. 12. DETAILS OF MECHANISM OF THREAD MILLING ATTACHMENT FOR THE LATHE

The attachment consists of a frame casting carrying the cutter spindle in bronze bearings. This spindle is made from tool steel hardened and ground on the journals. The cutters which are provided are made of high-speed steel and are, therefore, capable of cutting any thread at a single cut, without the necessity of a second operation. The drive is from a special countershaft, or rather a combination of two countershafts, one of which is similar in type to that which is usually furnished with an engine lathe;

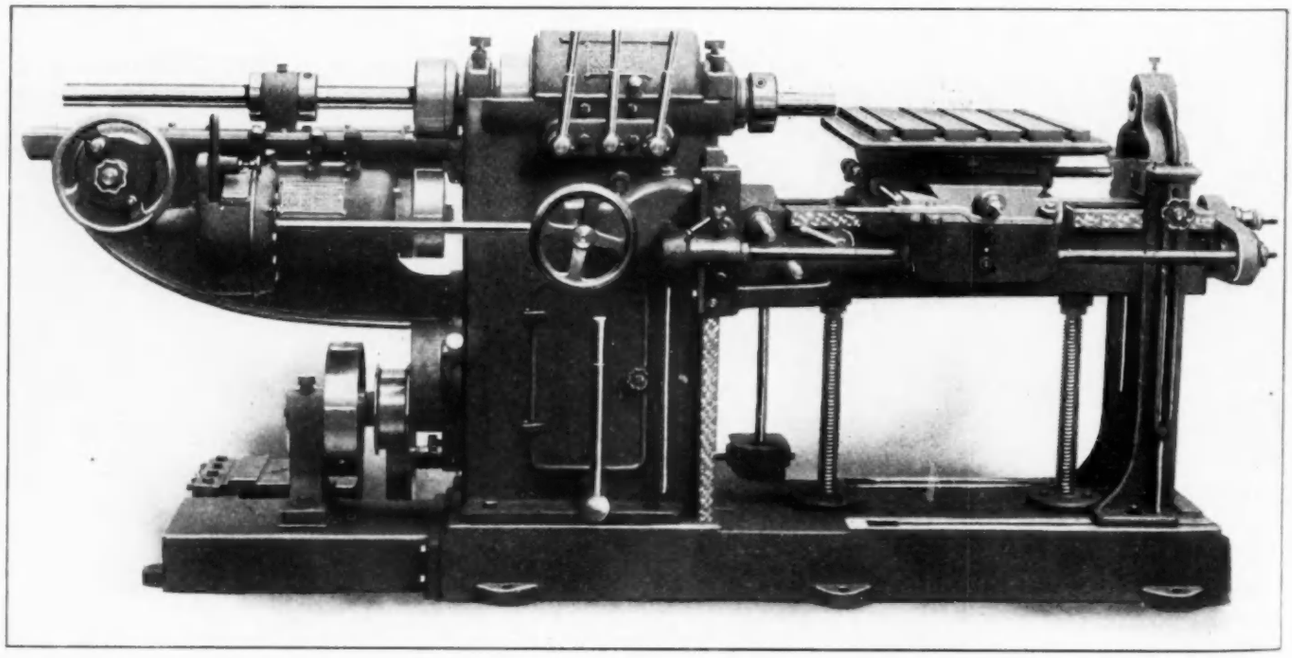


FIG. 10. A HORIZONTAL BORING MACHINE FOR ELECTRIC DRIVE

the other consists of a large drum from which a belt drives the pulley on the thread-milling attachment. Referring to Fig. 12 the attachment is carried by a bracket 2, which is held by the block 1; adjustments are made through the spindle *O*1 and the hand-wheel 4. The cutter is fed into the work at proper depth by means of the worm *O*17 and the graduated wheel *O*14. The drive is through the pulley belt 3, and the gears *O*9, *O*10 and *O*12 to the cutter spindle *O*4. The cutters are threaded and screwed to the cutter spindle.

Referring to the other illustration, Fig. 11, the belts *R* and R_1 are the belts of the ordinary lathe countershaft. The belt R_2 connects the regular countershaft with the drum which drives the thread-milling attachment. The ratio of speeds is such that the thread-milling cutter revolves five turns while the drum revolves 150 turns. The direction of rotation can be changed by use of the regular lathe countershaft, and a shifting position of the clutch *E* either starts or stops the drum; thus the lathe can be used for ordinary lathe work with the drum idle, or can be used for the thread-milling operation with the drum in motion.

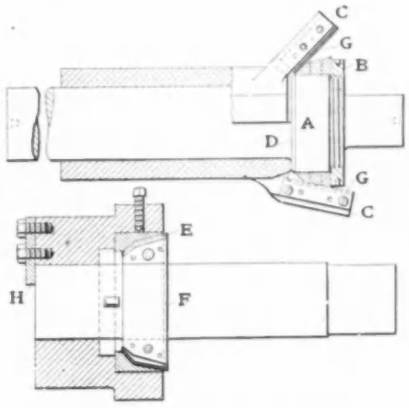
A Special Lathe Rest

An interesting special lathe rest for both plain and taper turning is built by de Fries & Co., Düsseldorf, Germany. The attachment in place on a lathe is shown by Fig. 13. The device consists essentially of two slides properly mounted and controlled by operating mechanism; motion is taken from the feed-shaft through a system of gearing which connects with both slides of the rest. Thus the slides can be operated at any point on the length of the lathe bed.

Standardizing Metallic Packing Rings

By R. Langnickel

To every engineer the disadvantages and troubles of metallic packing rings, such as are cast or home machined, are a familiar subject.



TOOLS FOR METALLIC PACKING

It is a matter of choice for every user of metallic packing rings to use unfinished packing rings with considerable steam-blowing until they are hammered tight, or pay a price of 15 cents a pound for machined goods and more for smaller sizes. In self-machining it has always been next to impossible to produce exact fitting angles.

A new tool has been designed that makes it possible to produce packing rings in exact duplication of each other. This includes N. Y. Metallic, Jerome and American Packing rings and can be used for any foreign packing, being effective by angularity. To secure an homogeneous angularity in vibrating cup and packing rings is the most essential point. This is done by the tool after good fitting rings have been cut from an exact bored bar in common machine-shop practice.

The outline and depth of vibrating cup is reamed by one tool, which gives a stop to operation as soon as tail end of reamer becomes solid against stop *H*. Depth of cup is then such that rings will be overlapped by cup for any amount desired.

The tailend of reamer is then introduced into bore of knife holder *C* and knives *G* are set to exact touch.

Rings are put on mandrel *A* pressed solid by jamb nut *B* and all to be done is to push the knife holder against rings until it becomes solid in *D*, when cutting ceases.

One arm of knifeholder may rest on a lathe tooth holder and the pushing against rings is done by hand.

As a substitute for the ordinary forms of wall paper there has been introduced on the market in India a new damp-proof wall covering made from raw copper. The material varies in thickness from 0.0012 to 0.006 of an inch and is capable of being worked into any kind of a pattern. Aside from its great wearing qualities, it is insect-proof as well as damp-proof, and this latter quality will aid materially to the comfort of dwellers in India, particularly in the rainy season.

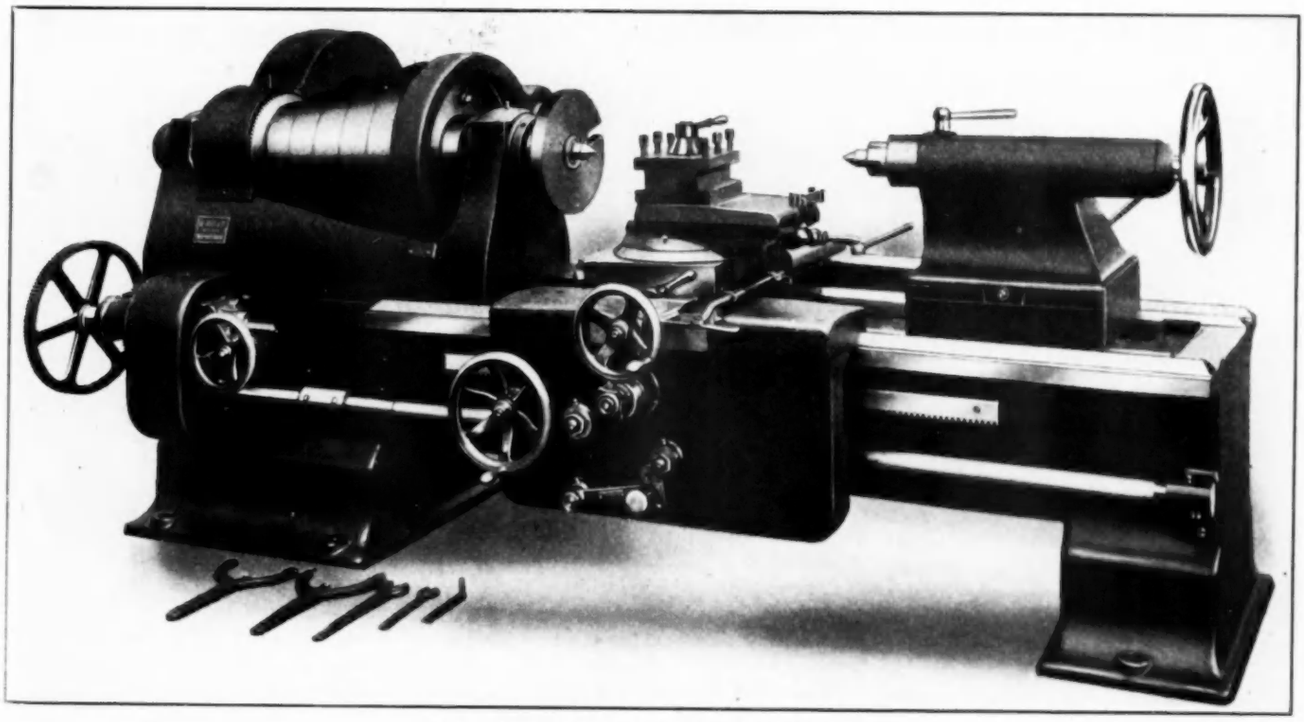


FIG. 13. A SPECIAL LATHE REST IN POSITION

Sub-press Tools and Their Uses in Watch Work*

How Sub-press Dies for Manufacturing Howard Watch Wheels and Other Parts Are Constructed by Means of Special Appliances

BY F. A. STANLEY

Of the many tools employed in watch factories, none is more important than the sub-press, in which are made the various small punchings utilized so extensively in the product of such establishments.

Some idea of the extent to which sub-presses are used in the E. Howard plant at Waltham, Mass., may be gathered from the half-tone engraving, Fig. 1, which represents the interior of the vault where these tools are stored when not in service. There are hundreds of sub-presses in this vault, each fitted with tools for a certain piece of work, and ready to be slipped into place in the power press whenever required.

Types of Sub-press Tools

There are many interesting operations performed by these tools; for example, blanking, piercing, trimming, swaging and burnishing of different parts, and the punches and dies are necessarily made with the highest degree of accuracy. With the piercing tools certain openings are formed in steel as well as in soft metal, which are so minute as to resemble fine pin holes hardly discernible to the naked eye and yet straight and accurate to size and correct in contour. Swaging dies, used, for example, on wheel blanks in which teeth of the required form are afterward to be cut, give the arms and rim of the piece a nicely formed edge; and burnishing dies facilitate the manipulation of many peculiarly shaped blanks, whose edges present awkward surfaces to finish properly by any ordinary polishing process. When such work is pressed through the burnishing die, it emerges with an exceedingly smooth finish around the entire periphery.

Punches and Dies

A miscellaneous collection of Howard watch parts as they appear upon coming from the sub-press are shown in Fig. 2. Some tools used in connection with the production of such parts are illustrated in Figs. 3 to 6.

In making such press tools, usually a master punch, of which several are shown in Fig. 3, is finished, and then the actual working tools are made. The master punch is worked out to shape by master plate and other refined processes and constitutes a permanent reference piece for all punches and dies for that particular piece of work. When making the press tools, the master punch is brought down on the die blank, the surface of the latter marked, and the die worked out to the required form. It is then hardened and after the punch has been worked down closely to the necessary size and form it is finished by shearing it through the die. The dies are quite frequently made in halves to enable them to be finished more readily.

A few plates which facilitate the construction of punches and dies and master punches are shown at the right of the engraving in Fig. 3. The small fixture seen near these plates, carrying a clamp collar on the cylindrical projection, is used as a holder when grinding one side of a D-shaped punch which performs a delicate piercing operation.

A Set of Wheel Tools

Figs. 4 and 5 illustrate in detail a sub-press and set of tools for a five-armed brass wheel. A number of such wheels are shown in the foreground of Fig. 4.

FIG. 1. THE E. HOWARD SUB-PRESS VAULT

with the strip of stock from which they are punched. As suggested by the appearance of work and stock, the wheels as punched from the strip are returned to it again by the shedder and are carried along out of the press as the stock is fed through.

It will be seen that the punch is made up of five sections *A*, Figs. 4 and 5, for

*Copyrighted, 1908, by Hill Publishing Company.

FIG. 2. HOWARD WATCH PARTS MADE IN THE SUB-PRESS

the five openings between the wheel arms, these sections when assembled being secured in a holder *B* which also carries the piercing punch *C* for the central hole in the wheel. The outside die *D*, Fig. 5, by which the wheel is blanked is located as represented, with the shedder *E* occupying the annular opening between die *D* and the exterior of punch sections *A*.

The lower die is composed of a central spider *F* milled out so as to leave five ribs of the right thickness for the arms of the wheel, and over this central member is tightly fitted a shell *G* having shallow, vertical grooves in the interior to receive the edges of the ribs and prevent them from springing sidewise when the die is in operation. The die case *H* and bottom shedder *I* are arranged as indicated in the sectional view. Other details of tools and subpress are shown clearly in Figs. 4 and 5; and the manner in which the sub-press tools operate to produce the wheel will be understood upon inspection of the sectional drawing, making further explanation unnecessary.

Making the Punches and Dies

Some appliances used in making the sectional tools shown, are illustrated in Fig. 6. The five punch sections, three of which are seen at *A*, are first cut from stock of suitable section, a length of which will be noticed at *J*. The pieces are then held one at a time by the bench-lathe appliance *K*, which consists of a chuck-shaped body fitting the lathe spindle and having an extension milled out to receive the punch blank. The latter is held by the clamp collar and turned down nearly to the required radius, enough stock being left for finishing by grinding.

After the five pieces in the set have been handled in this device, if put together they would form a cylindrical plug having a taper shank, and with the angular contacting faces and the curved exteriors matching perfectly.

A Grinding Operation

It is obvious that the radial faces of the punch sections must be ground away along the working ends to provide openings of the right width to form the arms of the wheel. Therefore, after the hole for the center punch *C*, Fig. 5, has been bored and the punch sections hardened, they are attached to the fixture *L* with the flat faces exposed for a surface-grinding operation.

Prior to placing the work on this fixture the flat plate *M* is clamped to the upper face of the fixture, and then two

FIG. 3. TOOLS USED IN CONNECTION WITH SUB-PRESS WORK

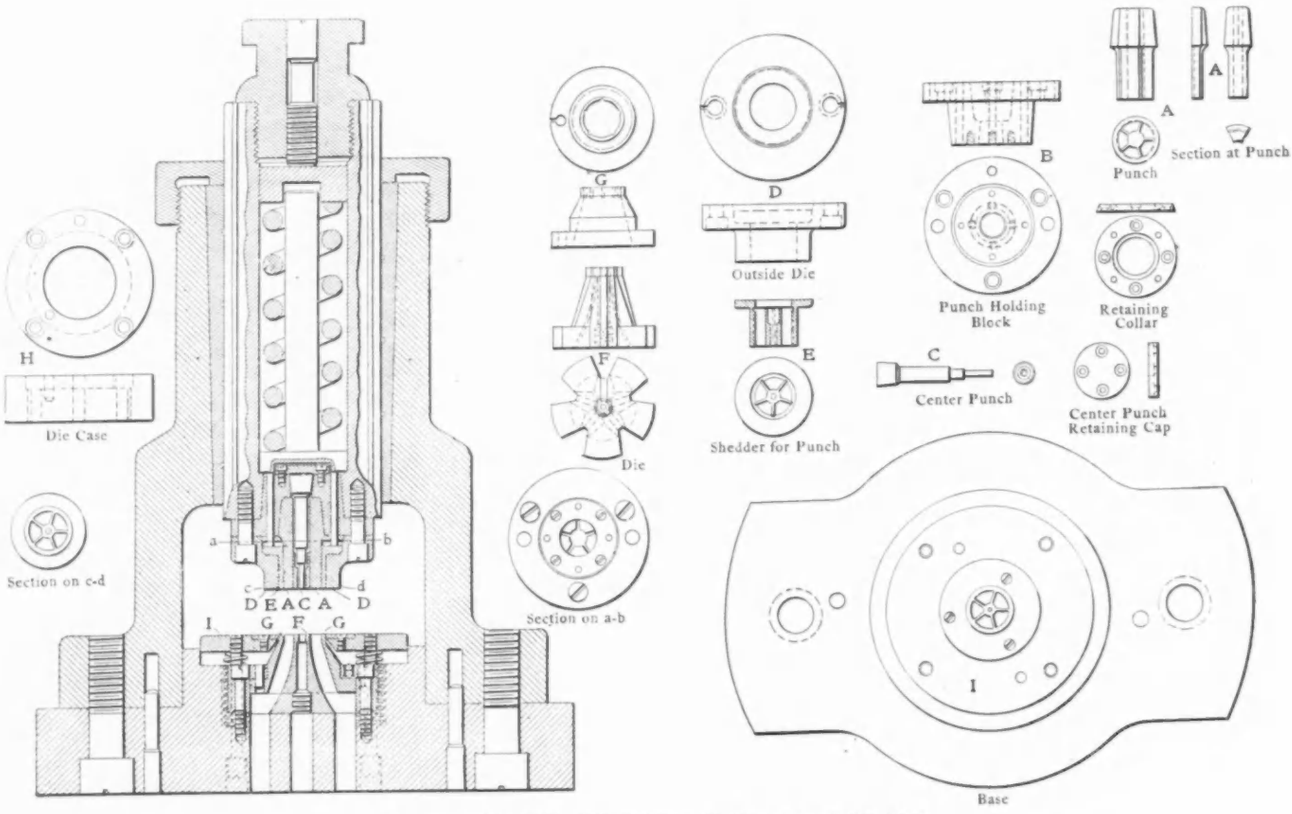


FIG. 5. SUB-PRESS AND WHEEL-DIE DETAILS—HALF SIZE

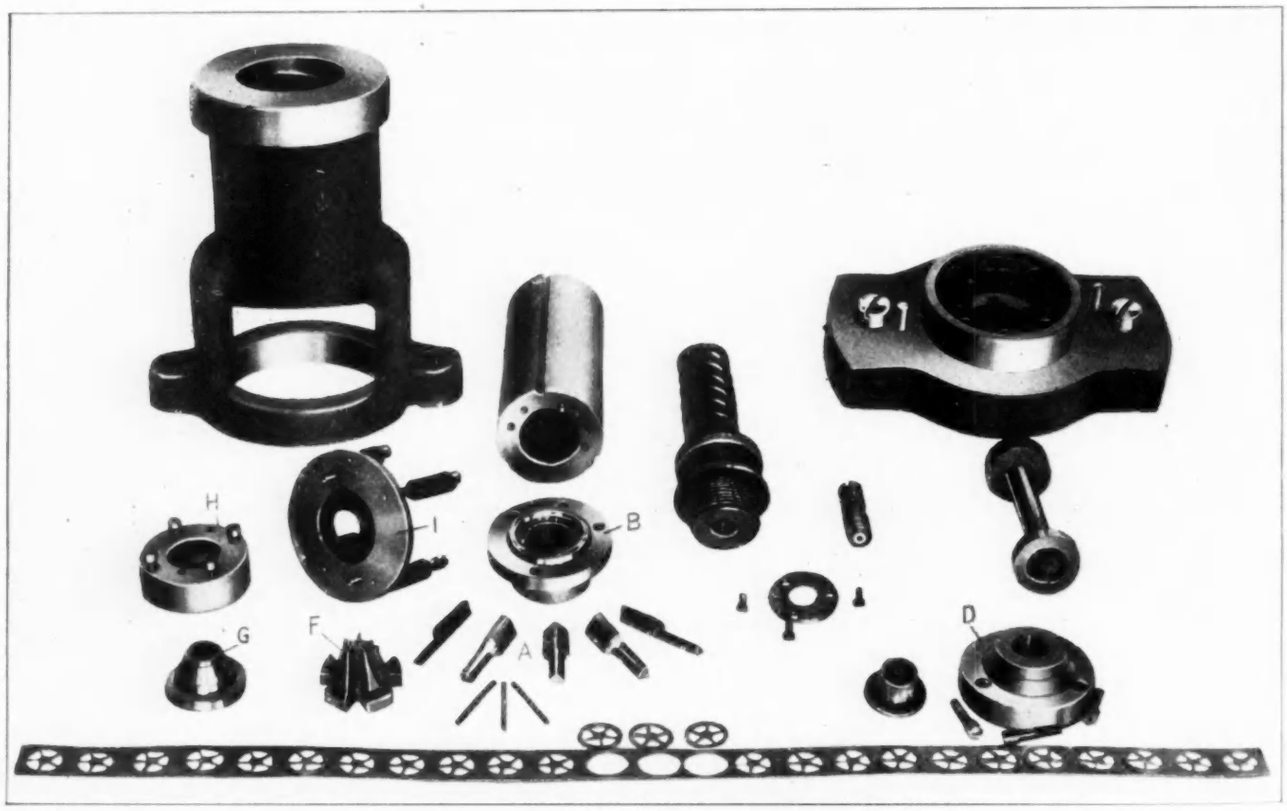


FIG. 4. SUB-PRESS AND WHEEL-DIE DETAILS

punch sections are located against the under surface of the plate *M* and soft soldered to the sides of the fixture. The locating cap *M* is now removed, as seen in the half-tone, leaving the surfaces to be ground projecting slightly above the fixture face. It is then an easy matter to grind the punch faces correctly on the surface grinder, and after completing one side of each to relocate them the other side up and grind the second face. In this manner the space required between the punch sections for forming the five arms of the wheel are easily and accurately obtained The lower die member *F*, whose vanes correspond in width to the openings between the punch sections, is milled out with an angular cutter of the type seen at *N*.

An Old-time New England Machinist, Seth Wilmarth, Union Works, Boston

By Wanderer

One of the most prominent figures in the mechanical world of New England from 1836 to 1855 was Seth Wilmarth, who conducted a machine shop in Boston, Mass., during that period.

Through the courtesy of a resident of the neighborhood, I have recently been furnished with data concerning the plant, etc., of Mr. Wilmarth, collated from old-time directories of Boston now on file in one of the libraries of that city, and therefore reliable, which is more than can be said of much that is published now-a-days on the plants and machines of long ago.

According to this data the name of Seth Wilmarth appears in the directories of 1836 and 1837 as a member of the firm of Graham & Wilmarth; in 1838 and 1839 as "machinist, Front street." During these years his residence is given at a different street addresses, but in 1840 both shop and residence appear to have been on the same thoroughfare, Front street.

In 1841 both shop and residence are recorded on Harrison avenue, but were probably in the same buildings as before, the name of Front street having been changed at that time to Harrison avenue on account of the filling in of a portion of the bay having nullified the old name.

Thenceforth until 1848 his shop and residence addresses continue on Harrison avenue, the numbers varying somewhat in the different years.

Thus far his output consisted, according to his advertisements in these directories, of "machinists' tools of all descriptions; including turning lathes of sizes varying from 9 feet to 50 feet in length, and weighing from 1½ to 40 tons each, the latter capable of turning a wheel or pulley 30 *feet in diameter.*" Among other machine tools manufactured are named boring machines, planers, drills, slotting machines, punching presses, gear and screw-cutting machines, mill gearing, shafting, etc.

By 1848 Mr. Wilmarth must have considerably enlarged his plant, as in addition to the tools already enumerated, we find locomotives, stationary steam engines, steam boilers and supplies for motive power and permanent way departments of railways.

During the next four years practically the same advertisement is continued except that locomotives are the first mentioned in the list of manufactures.

In 1853 no advertisement was found, but may have appeared and been torn out, as the consecutive numbers of the pages were not observed by the collator. The last appearance of the advertisement of this establishment was in 1854, and it was then somewhat reduced in size.

The works were evidently not entirely closed at this time, as in the body of the directory for 1855 the name of the proprietor is followed by "machinist, foundry S. B." (South Boston). In 1856 the only entry pertinent to this article is, "Mrs. Seth Wilmarth, 74 Dover," which indicates the death of Mr. Wilmarth during 1855 or 1856.

During the last six or seven years of the plant's existence its locomotives were placed on a number of roads. One on a subsidiary line of the Pennsylvania was only retired from service in 1874, and a small one built about 1851 and owned by the Cumberland Valley Railroad Company is still in existence in running order. Photographs of three more are known to be in the hands of collectors.

The advertisement of 1848 referred to reads as follows:

UNION WORKS SOUTH BOSTON

Seth Wilmarth, Proprietor.

Manufacturer of Machinists' Tools of all descriptions, including

Turning Lathes,

Of sizes varying from 9 feet to 50 feet in length, and weighing from 1½ to 40 tons each; the latter capable of turning a wheel or pulley 30 *feet in diameter.*

Planing Machines,

Varying from 10 feet to 60 feet in length, and weighing from 2 tons to 70 tons each, and will plane from 7 feet up to 55 feet long, and 7 feet square.

Boring Mills, Vertical and Horizontal Drills, Slotting Machines, Punching Presses, Gear and Screw Cutting Machines, etc., etc.

also

Mill Gearing and Shafting, Locomotives, Stationary Steam Engines and Steam Boilers of the various sizes required. Parts Connected with Railroads, Including Frogs, Switches, Chairs, Hand Cars, etc.

Jobbing and Repairs.

And any kind of work usually done in Machine Shops, executed at short notice.

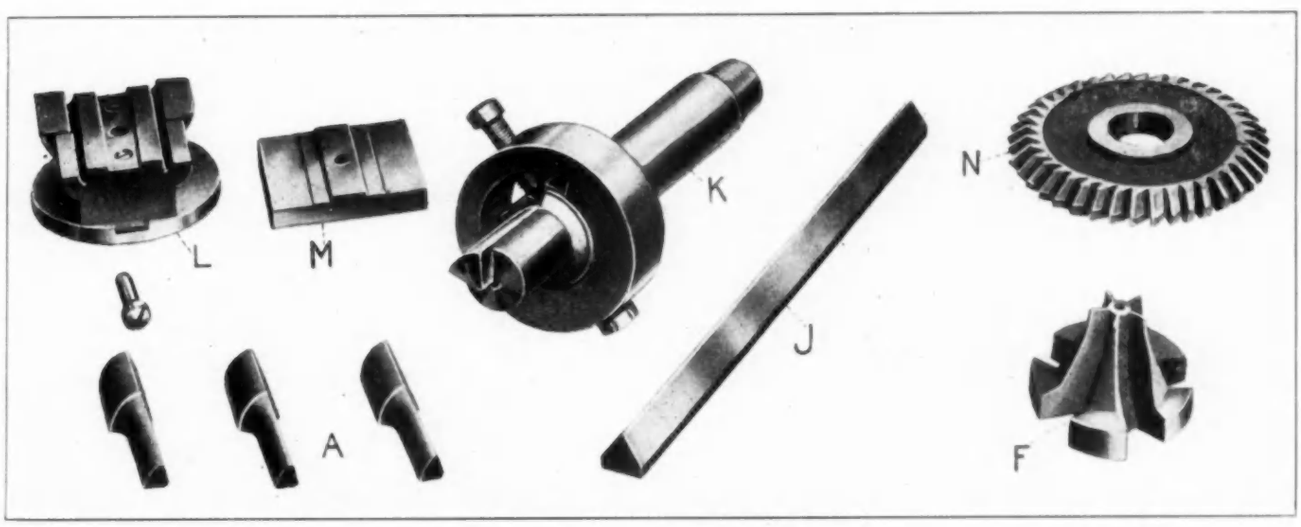


FIG. 6. TOOLS FOR MAKING WHEEL DIES

The Time Required for Machine Work—III

Examples of Large Turret Lathe Work of Various Kinds That Should Help in Estimating or in Selecting Machines for Different Work

BY FRED H. COLVIN

Several good examples of large work in cast iron on the Gisholt turret lathe are shown herewith. The first six are all steam-engine work of various sizes, three cylinder heads being shown in Figs. 1, 2 and 4. The first is for an 18-inch cylinder, and is to be 18¼ inches where it fits into the counterbore, all the surfaces which are marked *f* being finished in addition to those bearing dimensions. This is a good-sized head, and was finished in an average time of 50 minutes.

Fig. 2 is a different style head, not quite as large as the first, but fully as hard to machine. The dimensions are shown and all the finished surfaces are indicated in the same way. This piece required 60 minutes to finish. Another smaller cylinder head is shown in Fig. 4, this being for an 11-inch cylinder, with all the other dimensions and finished surfaces indicated as before. This took from 40 to 45 minutes.

Fig. 3 shows a piston-head for a 16-inch cylinder with all the plain surfaces turned to the dimensions shown. The grooves for the piston rings are cut and the taper holes for the piston-rod bored, the whole thing being completed on an average of 35 to 40 minutes each.

The piston spider and follower, shown in Figs. 5 and 6, are also machined in the same way, being in this case for 16-inch cylinders, and being finished as indicated both by dimensions and finish marks. These are each made in lots of 20, and the average time for each spider was 35 to 40 minutes, while the follower was made in from 15 to 20 minutes, the time of

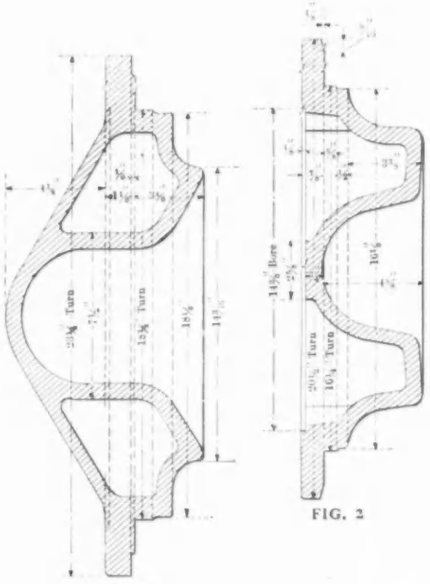


FIG. 1

FIG. 2

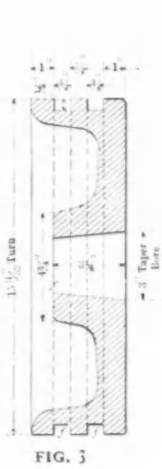


FIG. 3

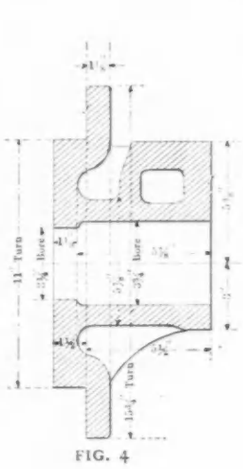


FIG. 4

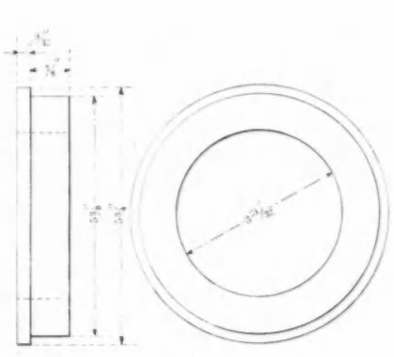


FIG. 7

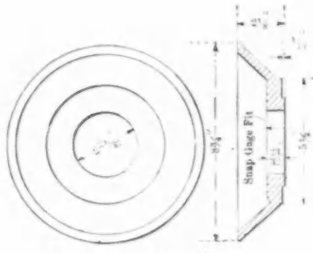


FIG. 8

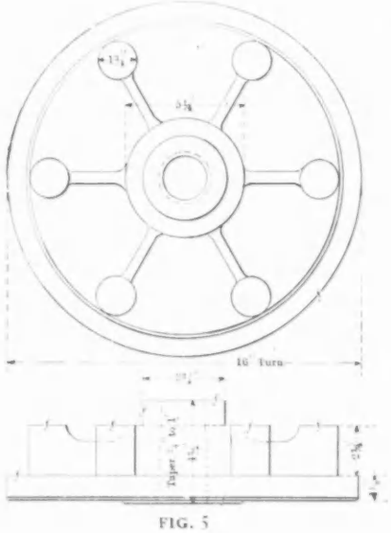


FIG. 5

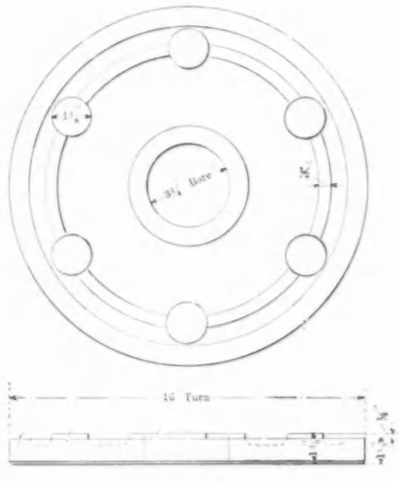


FIG. 6

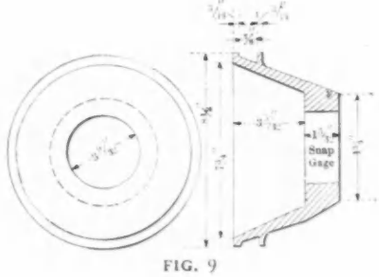
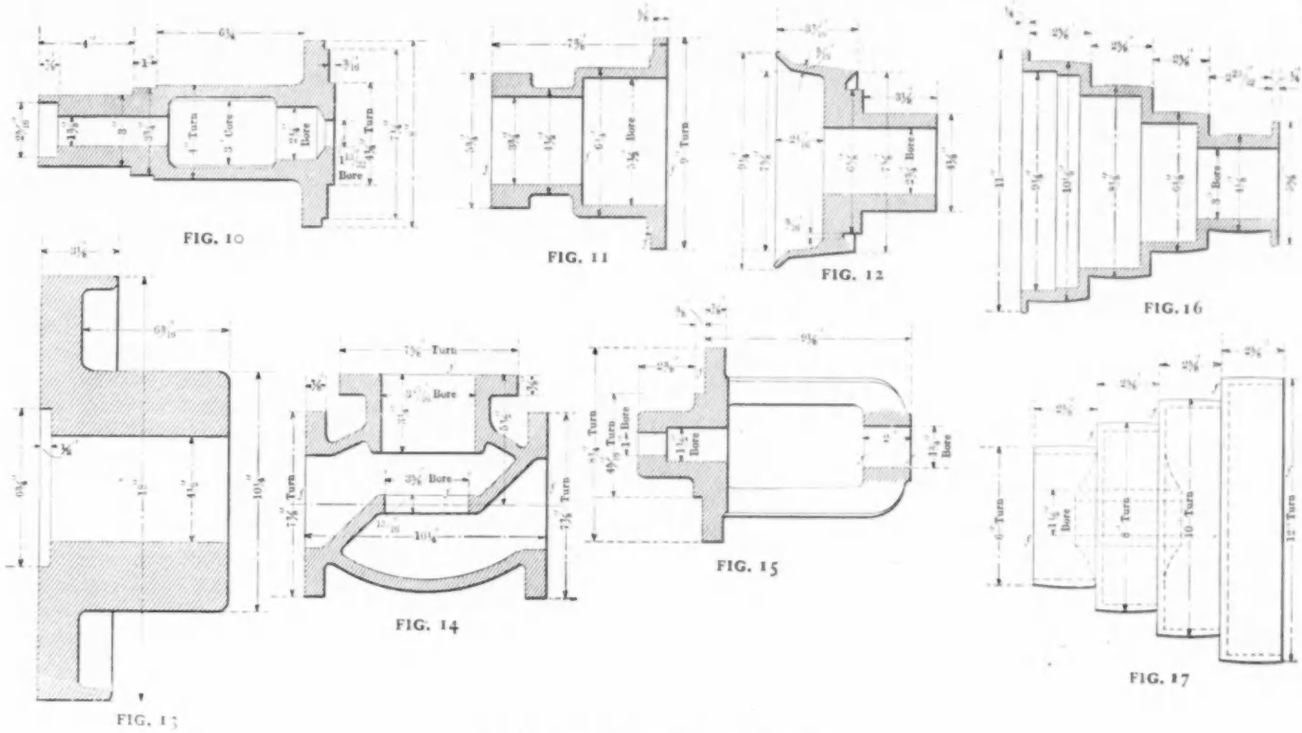


FIG. 9

CYLINDER HEAD, PISTON AND MALLEABLE-IRON WORK



A VARIETY OF HEAVY CAST-IRON WORK

setting tools being included in all the cases.

Malleable-iron Work

Going from cast iron to malleable iron we have a lot of 39 collars finished all over to gages to the sizes shown in Fig. 7, with an average time of 10 minutes, including setting up the machines. Figs. 8 and 9 show two malleable-iron thrust collars made up in lots of 15, finished all over to the dimensions given, Fig. 8 being completed in 30 minutes and Fig. 9 in 40 minutes.

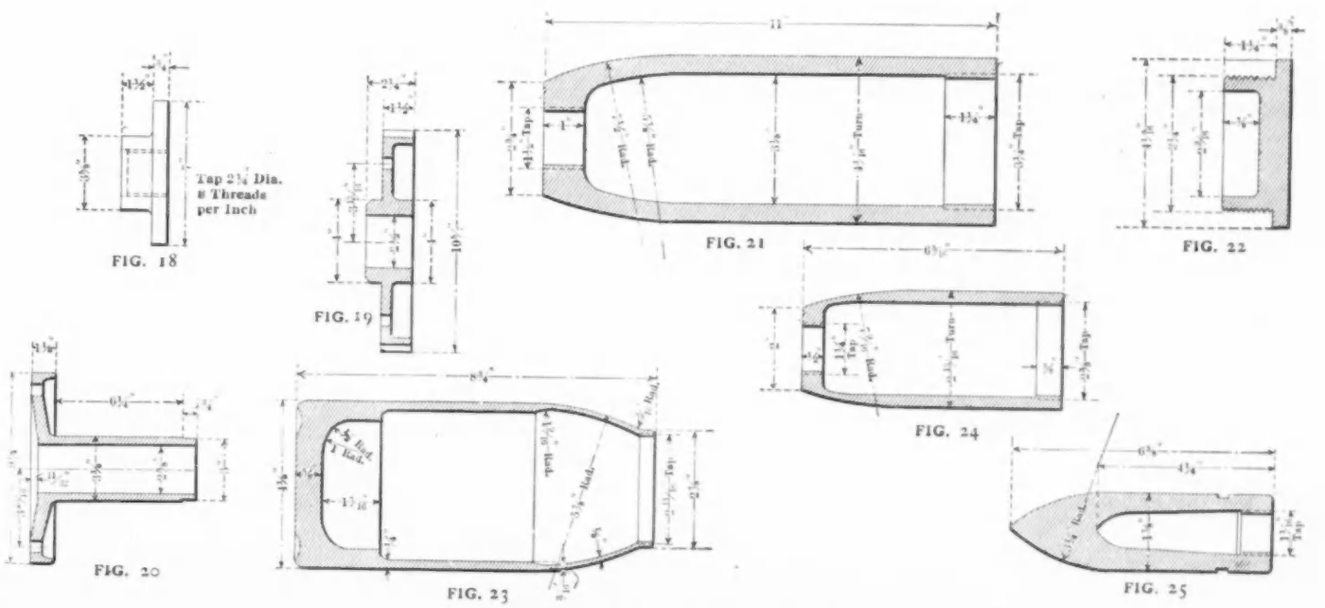
An entirely different class of work is shown in the figures which follow, the material being cast iron in each case and all the dimensions being given. Figs. 10 to 13 are finished all over in the following time: Fig. 10, 45 to 50 minutes; Fig. 11, 25 minutes; Fig. 12, 60 minutes, and Fig. 13, 45 to 50 minutes.

Fig. 14 is an iron-bodied globe valve finished as indicated both by the dimensions and the finish mark and was completed in 45 minutes. Fig. 15, while not finished all over, still has considerable work on it as indicated, and was completed in 25 minutes.

Operations of Pulleys and Gear Blanks

Two cone-pulley jobs are shown in Figs. 16 and 17, one being for the lathe head, and the other for the cone on the countershaft. They are entirely finished on the outside, and Fig. 16 is bored on the inside at the ends to the dimensions shown; while Fig. 17 is only bored for the shaft. All the dimensions are given, and the time on Fig. 16 ranges from 75 to 90 minutes each, while in Fig. 17 it runs from 45 to 55 minutes.

Fig. 18 is a small face plate threaded 2¼ inches in diameter with eight threads



FORE PLATES, GEARS AND PROJECTILES

per inch, and to the other dimensions shown. This was finished all over in 15 to 20 minutes.

Fig. 19 is a gear blank evidently for the face gear of a lathe and has to be finished all over. All the dimensions are shown, and the total time for turning the blank is 25 minutes. Fig. 20 is a quill or sleeve, also finished all over and to the dimensions given in 30 to 35 minutes.

Turning, Boring and Threading Projectiles

Fig. 21 shows the body of a projectile made from soft-drawn steel and finished all over to the dimensions given. This includes turning and boring and threading the back end for the cap shown in Fig. 22. The time occupied on the body of the shell is from 35 to 45 minutes. The cap, Fig. 22, is a steel casting, threaded to fit the body of the projectile. These are completed in from 25 to 30 minutes.

Fig. 23 is another projectile body also of soft steel, in which the ends are closed down after the machining has been done in the lathe. After being closed down the small end is tapped out for the projectile nose or point. All these dimensions are given and the time occupied was 30 minutes. Fig. 24 is the body of a smaller projectile and is a much simpler job than the other. This is also made of soft-drawn steel, and is bored, turned and cast in from 20 to 25 minutes. Fig. 25 is a still smaller projectile, and is made from the bar in from 20 to 25 minutes, depending upon the hardness of the material. All the dimensions are shown.

Machining Brake-drum Lining Rings for Automobiles

By Sydney Lawrence

A soft gray-iron drum lining ring for an automobile is shown by Fig. 7. These rings are cast in pots as shown in Fig. 1, with bolt holes cored in at the bottom, for securing to a faceplate. These rings have to be turned out quickly so we designed the tackle here shown and it has reduced the time from 37 minutes each down to 18 minutes, with the same accuracy as before.

Fig. 2 shows the bottom of the "pot," as cast, with the bolt holes cored in. They are cast vertical, and all the dirt rises into the end with the 4 lugs, which is not used but melted over again.

The first operation is to grip the casting in a 4-jaw independent chuck, in a turret lathe, as shown in Fig. 3, and face up the bottom end with the two tools X in the tool post; this operation being completed, the castings are next bolted on a face plate as shown in Fig. 4. This gives a very rigid drive, and prevents distortion. Referring to the turret tool post, in Fig. 4, the first operation is to face up the outer end true, with the tool A. The roughing tool B is next brought into operation, and the longitudinal feed thrown in. While the outside is being turned the inside is bored with the boring head E, secured on the boring bar by a driving cotter J. The cutters M are held by the setscrews N. The end of the boring bar is supported in a bush which fits in the lathe spindle. After roughing the finishing tool C is brought into operation on the outside, and the finishing boring tool brought into position in the turret. This completes the boring at the same time as the finish turning tool C completes the outside. The drum being bored and turned to size, the spacing and parting-off tool D in the tool rest is brought into position. This is shown in plan, and end elevation in Fig. 5, and the parting-off tool in Fig. 6. D is a forged steel tool holder, G is the adjustable spacing gage, for parting the rings off to the correct width. It is secured by the setscrew H. I is the parting tool 1 inch deep by ¼ inch wide ground as shown in Fig. 6, so that the point K always severs the ring at the correct position, and does not leave a bur on the edge, which it would do if ground square. After the completed ring has dropped off the parting tool is fed in until the point marked L cuts all the burs off the edge of the next ring. The tool is then withdrawn, and the rest fed along, until the spacing gage G abuts on the outer edge of the casting. The operator then feeds the tool in and parts another ring off, and so on. When the last ring is parted off, the remaining portion of the casting is thrown on the scrap heap. Figs. 8, 9, and 10 show the cutter head for boring the rings. It carries 4 round steel cutters as shown, and is made of gray iron, in a universal milling machine, after being previously bored and turned in a lathe.

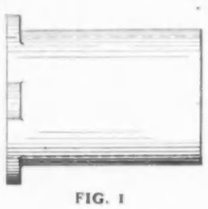


FIG. 1

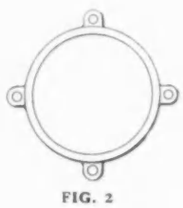


FIG. 2

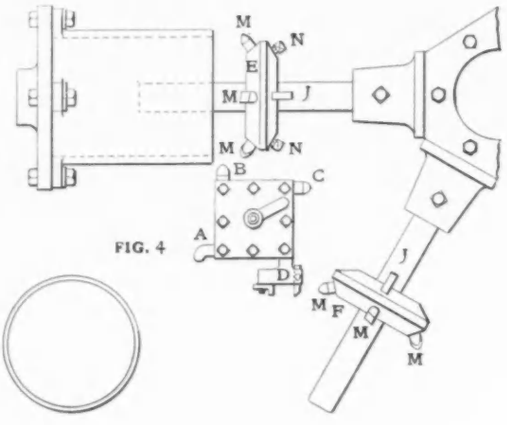


FIG. 4

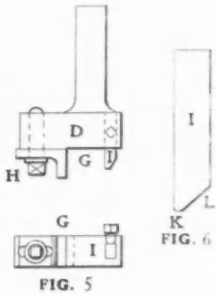


FIG. 5 FIG. 6

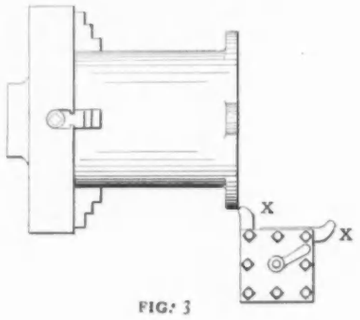


FIG. 3

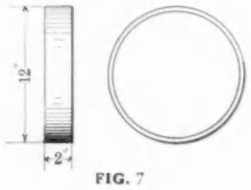


FIG. 7

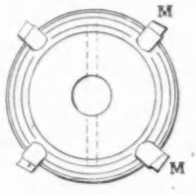


FIG. 8

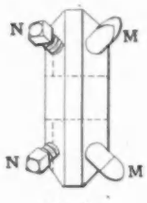


FIG. 9

FIG. 10

MACHINING BRAKE-DRUM RINGS FOR AUTOMOBILES

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Subpress Perforating Die

It is generally considered bad practice to use perforating dies in a long stroke press as they usually do not give satisfaction. Recently I got an order to build a perforating die for fruit graters for a press with a stroke of 3½ inches. The die had to punch 4 rows of 28 holes each, and from one side of the holes to a lip, as shown in the half-tone, Fig. 1. The holes in the die were No. 45 drill size, 8 holes to the inch.

To overcome the long stroke of the subpress, the die illustrated in the sketch below was designed by me, and proved a success.

Fig. 2 shows the assembled die. The bed plate of the die *A* is a machine-steel plate, onto which the subpress housing *B* is fastened by means of four cap-screws *C*. Into this subpress housing a machine-steel sleeve *D* is fitted, a nice, sliding fit. This sleeve *D* is planed at the bottom to receive the punch plate *E*, which is fastened to the sleeve by 6 flat-head screws.

The lower die *F* is fastened to the machine-steel bed plate by six flat-head screws in proper alinement to the punches.

The stripper *G* is fitted to the punches a nice sliding fit, and four ⅜-inch pins *I I* (two of them only shown) provide a guide for the stripper. The four pins *I* are a driving fit in the bed plate *A* and in the subpress housing *B*, and are a sliding fit in the stripper *G*. Two slots are worked through the subpress opposite each other at *K K* and two ½-inch tapped holes put in the slide *D*. The two screws *L L* are screwed into the sleeve *D* to prevent it from turning and from being pulled out of the subpress.

The plunger *M* is made of machinery steel a loose fit in the sleeve *D*, and provided with a shoulder *N*. The sleeve *D* is threaded at the top and the ring *O* is screwed onto the sleeve *d*. Fig. 2 shows the punches almost at the lowest position of the down stroke, and the punches (of which one only is shown) ready to penetrate the metal. Fig. 3 shows the sleeve with punches attached to it, and the plunger *M* in its highest position.

The advantage in a die like this is first that only about ½ inch (or 1/7) of the press stroke is needed for piercing the hole and stripping off the material and 6/7 of the time, the punches are at rest.

Fig. 4 shows the top view of the die *F*, and Fig. 5 the bottom view of the stripper *G* upside down. It will be seen that the holes in the die *F* are round holes, with one side worked deeper to make it appear oval on the top.

The stripper is exactly the counterpart of it, the little projections on the stripper fit in the depression of the die and are the forming parts for forming the grater lips on one side of the pierced hole.

The die is set like any other subpress die. The punches are set so deep into the die that the stripper and punch plate come close together; this is necessary, because the stripper has to do the forming of the grater lips, after the punches have pierced the material. The stroke of the press is then adjusted, so that when the crank is at its highest point, the shoulder of the plunger *M* has pulled the sleeve *D* with the punches up. In doing this the stripper goes up with the sleeve about ¼ inch and strikes the subpress housing at *P*, and strips the material from the punches. The punches stop in this position awaiting the down stroke of the plunger. In this manner the long-stroke press was used satisfactorily.

Buffalo, N. Y. JULIUS F. A. VOGT.

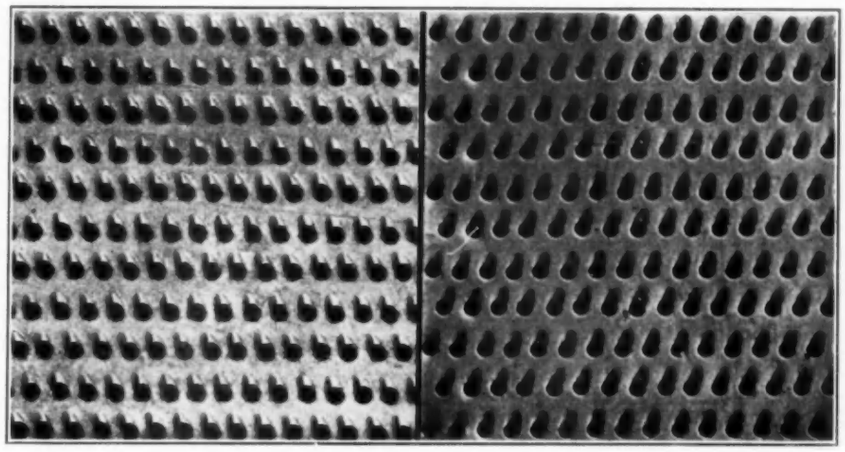


FIG. 1. THE WORK, BACK AND FRONT

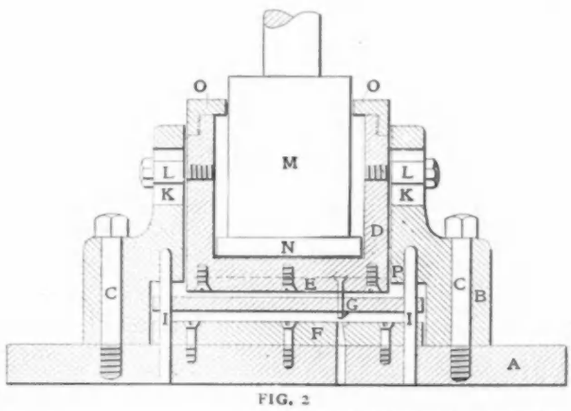


FIG. 2

THE SUBPRESS PERFORATING DIE

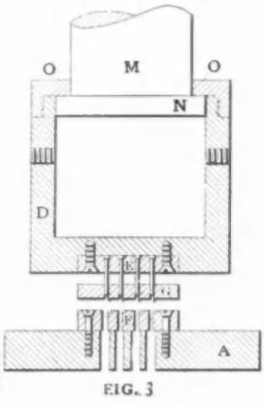


FIG. 3

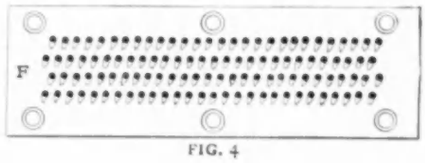


FIG. 4

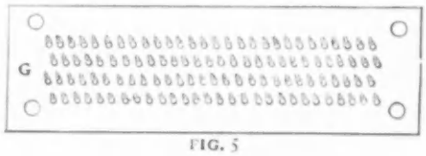


FIG. 5

DIE F AND STRIPPER G

A Bending Operation

While this is not an unusual stamping it has one difficult operation, forming up the lugs *A* Fig. 1 without breaking or destroying the holes. Fig. 2 shows the blanking die and punch, *A* is the tool-steel die block, beveled on the sides so as to be held in a bolster, *B* is the stripper, *D* the back gage, *C* the gage pin, *E* the punch holder with piercing punch *F*, blanking punch *H* and pilot pin *I*.

Fig. 3 is the first forming operation. The tool-steel block *B* is fastened to the machine-steel block *A*, this and punch *C* are milled 45 degrees to give the center of the blank and bend as at *B* Fig. 1. *D* is a pin held up by a spring and serves to hold the long end of the blank keeping it in the gages *E*.

Fig. 4 is the second forming operation. *A* is a machine-steel block, *B* a tool-steel block with the shape of *C*, Fig. 1, filed on *D*, the tops with the inner top corners being filed round, these give the lugs the upper bend. The punch *E* is filed on the bottom to conform to *B* plus the thickness of the stock, and milled on both sides at *F* reducing it to the thickness of the inside of the space between the lugs. *G* is the knockout which is held up by a spring on the rod *K*. Fig. 5 is the last operation; the piece is set on *A* with the short end in the hole *B* and the lugs resting on *A*. The punch *C* descending rolls it to the form at *D*, Fig. 1.

The stamping 1¼ inches long, is blanked of 0.049 cold-rolled steel with the holes 0.070 inch diameter pierced with the inner edge in line with the body. By first giving it the 45 degrees bend it does not draw or break as it would if it were bent up in one operation. By this way it is formed with the holes practically on a line with the body and closed only a few thousandths, also leaving this part only about the thickness of the stock wider than the rest of the stamping.

Chicago, Ill. E. E. KLICK.

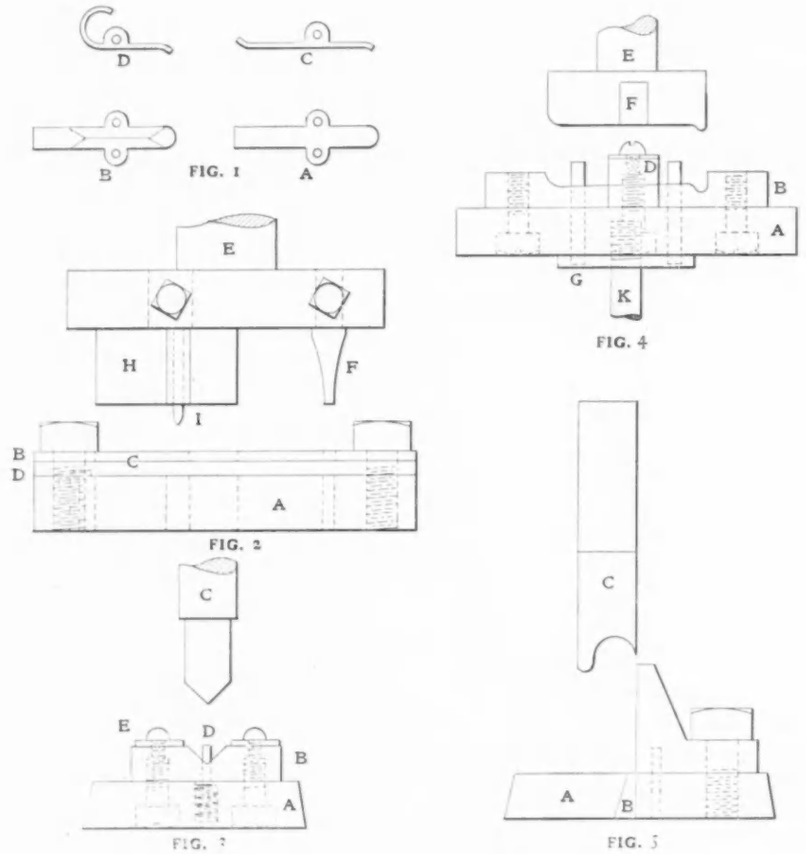


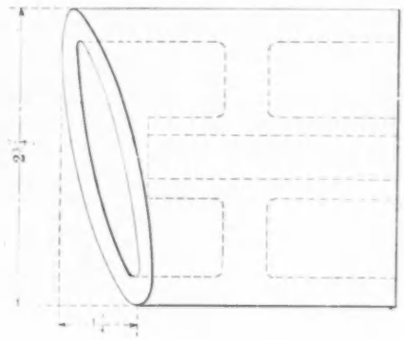
FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

THE WORK AND THE TOOLS

Making Face Cams on the Engine Lathe

I recently had a number of bronze rolls to make as shown. The face cam on one end is to reciprocate the roll as it revolves, by bearing against a small steel roller, the return being effected by means of a coiled spring around the boss. Having no cam-cutting attachment on the miller I thought I would try to do them on the lathe. On examination I found there was a full inch clearance all around the unthreaded portion of the lead screw. This suggested a way out. I first made a master cam in gray iron and set-screwed it to the lead-screw in front of the carriage, fitted a roller to the latter, and fixed up a cord and pulley with a weight to hold the carriage against the cam. Of course the lead screw had to be geared to run at the same speed as the lathe spindle.

The tool, which had to have sufficient clearance to cut on the retreating portion of the cam, was fed forward by means of the compound rest. Running at about 40 or 50 revolutions per minute (any greater speed made the weight



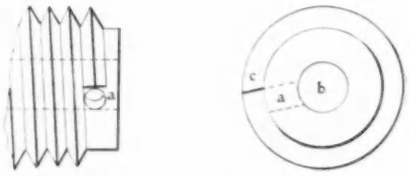
THE FACE CAM

jump) I obtained a very creditable job in an average time of from 3 to 5 minutes each for cutting the cams. The remaining part of the job, of course, presented no unusual features.

New York. JOHN P. WHEELER.

A Tap for Lead and Aluminum

The illustration shows the business end of a tap I have used successfully on aluminum and lead obtaining good smooth threads. It is made without flutes and has but one cutting point *C*. The holes *a* and *b* are to allow the chips to escape,



A TAP FOR SOFT METALS

the hole *b* extending clear through the tap, *a* being from the root of the cutting edge to the center hole *b*. The cutting edge *c* is not radial, but undercut.

I have also had good results from taps made of machinery steel, case-hardened when using them on lead.

Lowell, Mass. WM. B. HILLIARD.

Nickel steel has found its way into the manufacture of watch springs, and has gained high favor particularly in the manufacture of the finer grade of hair springs. Its strong aversion to rust and superior quality of retaining elasticity make it specially adapted for this purpose.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Machining Multiple-throw Crank-shafts and Those Ribbon Chips

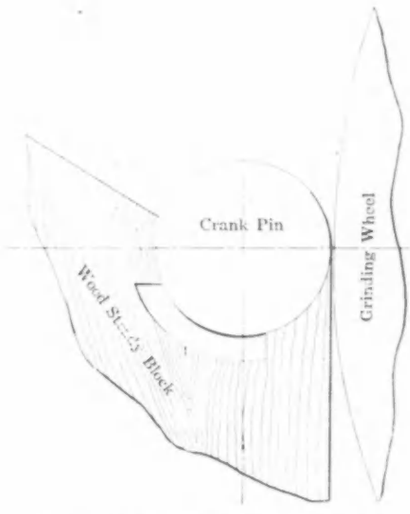
As a grinder hand I was much interested in the article of Mr. Spence on page 833, Vol. 31, of the AMERICAN MACHINIST, on the "Machining of Crank-shafts" at the Norton Company's works. I had previously met with two or three persons who have seen the work being done and have also seen one or two samples, which I must say are very creditable.

The most interesting thing about the article is the truly marvelous amount of time that is consumed in the different operations, and I wish Mr. Spence had been a little more explicit in the closing lines of his article. In the course of business it has been necessary for me occasionally to grind an automobile crank-shaft on a Norton machine, but must plead guilty to being a long way behind in the time as recorded by Mr. Spence. Reading the article, however, has among other things taught me that the method I followed was somewhat wrong.

I notice that it is the practice to leave some 0.035 to 0.040 of an inch for the finishing operation, which seems at a first glance an excessive amount, for we may assume that as the centering arrangement is not removed after roughing, the cranks would be practically true. From my own little experience I should imagine this large allowance to be a precaution taken against the natural elasticity of the crank, and here I may say that my greatest difficulty has been in getting them to grind round.

All the cranks I have ground have been previously roughed out in the lathe, leaving some 0.030 to 0.040 of an inch for removal, they have then been placed on similar center blocks to those shown by Mr. Spence and these were carefully made, but in spite of this the cranks would have the rough-turned parts some 0.015 to 0.020 of an inch, eccentric. This undoubtedly proves to me, from my difficulty in getting a truly round pin, that the cranks should be ground outright or that they should be both turned and ground without removing the center blocks.

Mr. Spence speaks of "springing the crank-shaft by too much pressure from the tailstock center," which is rather ambiguous. The Norton machine is provided with a spring tailstock center, therefore, does he mean that no spring tension whatever be used? The crank-shaft shown at Fig. 14, page 826 looks as if the slightest variation of spring tension would affect its truth. I have found that bringing the tailstock center up with the faintest amount of tension and locking the spindle until the crank is quite finished has given the best results. A precaution I have taken when doing this has been to mark the position of the hand wheel so that if, for any reason, I might have to remove the crank before it was finished, I should be able to give the center the same tension when placing it between the centers again.



USE OF WOODEN BLOCK IN GRINDING CRANK-SHAFTS

I know of one concern, who grind cranks successfully on a Norton machine and who have taken the spring out of the tailstock for the above reasons. They also use a solid wood steady block, as shown in the accompanying illustration, in preference to the segment pieces ordinarily used. As the roundness of the crank-pins depends to some extent on the shape and relative position of these segments the solid wood steady block has the merit of being more fool-proof.

The production of the steel-ribbon chips as described by Mr. Norton on page 451, Vol. 31, was very interesting reading. As an example of freak grinding they were no doubt worth recording, but that is all that can be said for them. This method of grinding, if we can call it by the name, is both dangerous and expensive.

Mr. Noyes in his criticism of this on page 807, Vol. 1, is I fancy rather misleading and he seems to have imagined that Mr. Norton objected to feeding a wheel into the work without traverse as a means of removing stock rapidly. That this is not so is apparent from the article by Mr. Spence of crank grinding on page 833, as carried out at the Norton factory. Mr. Spence does not tell us if he produces the ribbons in ordinary practice and I feel about certain that it would be a mistake to try with a piece shaped like a crank, nevertheless he does some remarkably rapid work in the way of shifting stock; he tells us on page 834 that he has seen occasionally a crank-pin about 2½x2 inches diameter reduced to 1.785 inches in 40 seconds, which means removing some 2.4 cubic inches per minute. On an elastic body like a crank this is a remarkable performance.

Mr. Noyes has apparently mixed the two things up, that is, grinding without wheel traverse and making ribbons; he speaks of reducing hardened spindles, but does not say clearly whether he gets ribbons from them or not. If he does so, I should say that it would be bad for the spindle to deliberately do what we always try to avoid in grinding, that is, to generate excessive heat in the work.

My own ideas of grinding may be preconceived ones, but I still fail to see any advantage that can be gained in striving to produce these ribbons, even to remove 1.75 cubic inches per minute. We are told that to produce them we must first allow the wheel to glaze. This means practically that we are letting what may be a good wheel, get into the condition of a poor one with all its entailing disadvantages. A principal advantage of machining by grinding is that we get rapid and accurate work with the minimum of cutting pressure, as compared with other methods, and consequently less danger of distortion, but if we use a wheel or allow a wheel to get into the condition advised for the making of these ribbons we would seem to be going backward. It would seem to be asking for trouble and also a wasting of time to try to make these so called chips, yet the real chips from a grinding wheel and the general condition of the residue is useful and instructive. By occasional examination we may tell whether the wheel is cutting efficiently and may collect useful data for work of a repetition character.

I saw an operator the other day, one of the thinking sort, who has reduced this latter feature to something of a fine art. He was at work on a Brown & Sharpe

universal machine, grinding the face of a case-hardened automobile bevel gear, with a 36-J alundum wheel 1¾x1¾ inches. This he fixed on the internal-grinding spindle. It was the beautiful appearance of the grinding chips, that came from the wheel, which first engaged my attention and caused me to enter into conversation with him. It was his practice, on all work of a repetition character, to take note of the appearance of the chips from his wheel and the amount of waste grit that was present in the residue. From these observations he has regulated the speed of his work and when the best combination has been found he makes a note for future use. He told me that with a little experimental speeding he is nearly always able to get a residue that is almost all chips and with little visible signs of waste grit.

In the present case I examined the chips carefully and found barely any traces of wheel grit, which proved that the particles in the wheel were being actually worn away.

Birmingham, Eng. D. SCHLIEFER.

Hardening Tools to Cut Extra Hard Steel

The letter of E. S. Wheeler, on page 660 of Volume 31, giving the result of hardening high-speed steel in water, greatly interested me, as I had made a similar experiment myself, with an equally satisfactory result.

In this case the tools hardened were angular milling cutters 2¼ inches diameter and ¼ of an inch thick. Five cutters were used in a gang to mill V-grooves in malleable-iron castings at 105 revolutions per minute, with a feed of 0.06 inch, giving a table travel of 6.3 inches per minute. These have now milled over a thousand castings, without resharpening, and are still in good condition.

I have also an 8-inch diameter high-speed inserted-tooth milling cutter working on malleable iron, and the teeth of these were hardened in the same manner. This when at work forms one of a pair, the other being an 8-inch solid cutter of the same brand of steel, but hardened by the makers of the steel in their own way. The water-hardened cutter mills on an average 30 per cent. more castings than the one hardened by the makers of the steel. I expect this treatment would not suit all brands of steel, but the results obtained with the brand I use favor me trying it again.

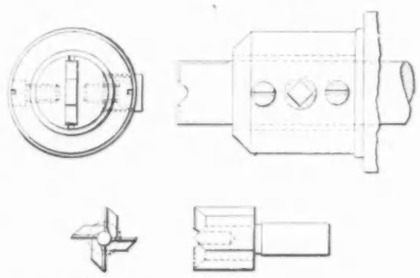
A few years ago I had given to me a way of hardening cast tool steel, so as to produce a tool capable of cutting hard steel. After heating the tool to be hardened to a cherry red we gave it a careful hammering, sharp, but not hard enough to disturb the shape on the cutting end, and then put it back into the fire; in the meantime we had at hand some lead melted to a bright red heat. When the tool reached a dark red again we removed the scale and inserted the end into the melted lead; then as soon as it reaches a bright red we dip it into cold water, moving it rapidly about until cold. It is then made ready for use by grinding.

With a flat drill hardened in this manner and using turpentine as a lubricant, I have had holes 1¼ inches in diameter drilled through 2 inches of manganese steel, after the best high-speed twist drills we could get had failed to make an impression.

Bradford, Eng. A. E. DODWELL.

A Cheap Butt Mill for Brass Work

The butt mills described by Ethan Viall on page 604 are substantially the same as made by manufacturers of valve milling machines.



TWO TYPES OF MILLS FOR BRASS WORK

The point wherein they differ from those with which I am most familiar is in their not having a hole in the end to enable them to be sharpened without resorting to the grinding operation shown in Fig. 4, page 605. It seems to me that it is better to remove that stock with a drill while the tool is soft than to be continually grinding it out after hardening.

The method described for making the mills is about what would be adopted by anyone having a few to make, but when made in large quantities the turret lathe comes into service and helps materially to cut costs. Using square stock, as in the method described, it is held in a square collet and the end for the shank reduced to within about 0.010 inch of finished size, by either a box mill or hollow mill, then centered and cut off. For the second operation they are held by the turned shank, and drilled and countersunk as shown by the cut. The next operation is to mill them to the shape shown. For this operation they are held in a spring chuck fitting an adapter in the dividing head of the milling machine. In the same chuck the ends are beveled as shown. After removing the burs left by the mills they are ready to be hardened and ground on the shanks and teeth.

Another style of cutter used for this class of work consists of a bar of flat steel ground on the end to form two cutting edges and held in a specially constructed spindle as shown by the cut. For cheapness this style of cutter is hard to surpass. W. R. G.

Making Metallic Packing

I shall be much obliged if your correspondent W. T. H., who wrote, page 466, Part 1, on the subject of "Making Metallic Packing," can supply any information regarding the deterioration in quality of packing rings cast in chills as compared with those turned out of the solid. Has his experience led him to believe that rings cast to the finished size and used without any machining are less successful than those machined out of the solid?

Doncaster, England. F. H. E.

This letter was referred to W. T. H., whose answer follows:

The article F. H. E. refers to is probably misleading in that no sizes are given. The packing shown ranges from 1 3/16 inches bore by 1¾ inches diameter to 1¾ inches bore by 2½ inches diameter, the thickness of rings being 3/16 inch.

With the larger sizes of packing it is our custom to cast each ring finished size separately in a metal mold, but on account of having so much trouble in obtaining good castings in the smaller sizes we adopted the method shown. We find it more satisfactory, also much cheaper. The stock used is cast in the form of a tube in a metal mold with a metal core. This core is a polished steel pin with very little taper, as very little stock is left for finish. We do not find any special advantage in machining all over if good castings are to be obtained. As to the wearing qualities we believe that the chill produces a more dense metal on the surface of the casting, and the less removed from the surface the better.

Springfield, Mo. W. T. H.

A Cam-grinding Rig

I have read with much interest the description of the cam-grinding rig on page 712 of the current volume. Now, if emery wheels never wore out this would be a very good rig, but as the wheel continues to get smaller the cams will be ground to a shape which will be gradually differing from the master cam, unless the stop against which the master cam works should have its shape changed continually to correspond with the ever changing diameter of the emery wheel.

The way we do this work in our factory (the Motorcar Company) is to use the side or edge of a cup wheel and run our master cam against a flat surface. In this

way the wear of the wheel does not affect the uniformity of the work.

Detroit, Mich. CHAS. A. TRASK.

A Gage for Use in Producing Accurate Tapers

I was very much interested in the article on this taper gage at page 458. The principle appealed to me very strongly as we find the ring-and-plug system unsatisfactory, but there is one point about this gage that is not very clear to me, and that is, after setting the knife edges to the model, and when trying the plug which we are grinding, how is the plug held in a *central* and *parallel* position in reference to the knife edges?

If Mr. Stutz thinks the question of sufficient general interest to answer in the columns of your paper, I shall greatly appreciate any information he may give.

Germantown, Penn. E. A. ERMOLD.

E. A. Ermold's question, "How is the plug held in a central and parallel position in reference to the knife edges," can be considered in relation to the two applications of the model.

The first application involves the making of a plug to conform to the previous setting of the knife edges.

We can assume that the knife edges have been properly set on the model, so that they are perfectly symmetrical to a line passing through the centers of the two disks, this line being parallel to the surface plate on which the model stands. Having proceeded so far, the question of providing an additional rig to hold the plug being made, while testing it, occurred to me, but I found in practice that this was not necessary, in order to obtain the desired result. Assuming a good toolmaker with a reasonably delicate sense of touch to be making the plug, I found that he could very readily tell when the plug was in a central and parallel position.

Holding the plug, which has previously been covered with a very light application of Prussian blue (water colors), by the two ends, he passes it in a horizontal plane between the two knife edges. If on examination two straight lines appear on the plug, due to the rubbing off of the Prussian blue by the knife edges, the plug is correct and finished. A little consideration will show that should the taper of the plug be ever so slightly different from the setting of the blades or knife edges, the toolmaker could not produce the two straight lines on the plug; and unless he does produce them, the plug is not of the required taper. The knife edges being thin (about $\frac{1}{8}$ inch for small plugs and about $\frac{1}{4}$ inch for large plugs) the toolmaker will have no trouble in the testing of the plugs. If Mr. Ermold will build a model and try it, he will find, as I did, that the problem presents no difficulty whatever. It is this very point which makes this apparatus such a desirable addition to the tool room.

The second application involves the correct setting of the knife edges to an existing plug.

Here the knives are set to fit the plug, irrespective of weather; the center line between the knife edges is parallel to the surface plate, the fitting of the plug to the knives being done with Prussian blue as mentioned above. The disks are then set and their diameters and center distance measured. If it is necessary that the small end of the plug have a certain predetermined diameter the size of the small disk can be calculated; a small disk for the small end is then made and the disks are now reset, so that a line through their centers is parallel to the surface plate. The testing of the setting with the plug is done as mentioned above and, as I pointed out, presents no difficulty in practice.

Pittsburg, Penn. C. C. STUTZ.

An Inserted Blade End-mill

Under this heading, on page 769 was an article by H. E. B. detailing a mill which he claims to have originated and found very good. I made a similar set for the same purpose about four years ago, and excepting the placing of the blades relative to the radial center lines and style of shank (these mills were used on W. & S. machines) I believe they are the same.

We found these very good and have been using them successfully on heavy nuts.

H. E. B.'s method of making clamp pieces is better than was ours, for we did not think to drill rings before sawing into blocks, but drilled them after clamping pieces in place.

Warren, O. P. A. LAWTON.

Roller Lathe Rests

For the benefit of Mr. Handley, and referring to his article on page 988, I wish to state that many makers of American lathes, for the past year or so, have furnished roller rests with their lathes.

Lowell, Mass. PAUL W. ABBOTT.

Welding Chain

Referring to an article on welding chain which appeared on page 949, I can scarcely agree with Mr. Barnes that his style of welding chain is either a trick of merit or advantage except in cases where new stock cannot be had to make new links for connecting the separate parts. A link that is cut and welded is seldom so neat or so strong as it was originally, and the time required to do a good job will exceed that used on a new link.

FIG. 1 FIG. 2

WELDING CHAINS

When new links are made they are usually bent and scarfed, as shown in Fig. 1. The end links of the pieces to be joined are placed one on each side of the link to connect them, which will be as shown in Fig. 2, when bent to shape and welded. The amount of space for holding with tongs and for heating and welding is very limited on new work, and will be more so on a link that has been cut providing the chain in question is of standard pattern. That there is a standard for chain does not seem to be any too well known. To give exact standard dimensions for all sizes of chain would necessitate giving a table in detail. But if links from $\frac{1}{4}$ inch up are made in accordance with Fig. 3, they will be so close to standard that the difference would never be detected except by measurement.

A	B	C	D	E
Size of Chain	Width of Link Inside	Width of Link Outside	Length of Link Inside	Length of Link Outside
	1¼ Times A	3¼ Times A	3 Times A	5 Times A

FIG. 3. DIMENSIONS OF CHAIN LINKS

Plainfield, N. J. JAMES CRAN.

The United States Geological Survey has been making investigations of the sand-producing areas in the United States, which was prompted by the remarkable development of the glass industry which is so largely dependent upon sand production, and as a result it was found that in 1905 the worth of glass produced approximated $65,000,000, the raw material for which cost about $18,000,000, of which sum $1,000,000 was spent for sand.

AMERICAN MACHINIST

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July 30	18,750

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None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The index to Part 1 of Volume 31 will be sent to any of our readers who send a postal-card request with name and mailing address.

Wage Earners' Life Insurance

The Massachusetts Legislature of 1907 passed an act permitting savings banks, incorporated under the laws of the State of Massachusetts, to establish departments to issue life insurance and annuity. A few weeks ago the first policy to be issued under this act was written by the Whitman Savings Bank Insurance Department. This savings-bank insurance is for wage earners, and is intended to draw its policy holders from the classes that are reached by life-insurance companies who write industrial insurance.

The act and the results that it aims to accomplish are of great importance. They are of importance to the wage earner, for they provide him with means for saving money for the years of old age; they provide means for caring for his family in case of his death; and they give one answer to the attention-arresting question: "Who will pay your wages when you are old and gray?"

They are of importance to employers, for they furnish one untainted way to carry on welfare and industrial betterment work. Savings-bank insurance and annuity departments may establish agencies, and such agencies can be taken out by employers for the benefit of their employees.

Again, this act and the results that will follow the carrying out of its provisions are of importance to thinking men in general, as they provide means for encouraging thrift, saving, and voluntary old-age insurance as distinct from compulsory insurance and eleemosynary pensions. The provisions of this act seek to make superannuated working people independent instead of dependent; to relieve instead of increase the burden of general taxation; to present as numerous and convenient opportunities for saving money as there are now opportunities for wasting money; and to give to those who save through its channels the largest possible proportion of the increase that their money earns.

Massachusetts is to be commended for living up to her traditions of encouraging thrift among her people. In this particular her act is in direct, favorable comparison with the paternalistic, compulsory, German insurance laws — old-age insurance laws that divide the insurance burden between employers, employees and the State—and with the attitude of England which, under the leadership of the Asquith ministry, is turning toward old-age pensions for wage earners, the expense to be met by general taxation.

The act was drawn with great care, and those who are especially interested in the movement believe that all of the essential points have been covered properly, and that all necessary safeguards have been provided. Some of the more general provisions are: The savings department of a bank is distinct from the insurance department; the investment of insurance funds is subject to the regulations that govern the investment of savings funds. Insurance can be taken only by residents of the Commonwealth of Massachusetts, and the limit of insurance that can be written by any savings and insurance bank upon the life of any individual is $500. Similarly, the limit of an annuity for any individual is $200. Both of these amounts are exclusive of dividends or profits. No solicitors, or house-to-house collectors can be employed; but other savings banks may become agents for a bank doing an insurance business; or other agents may be appointed under certain limitations. A corporate body is provided for, known as the General Insurance Guarantee Fund, to carry out certain specific provisions of the act, and to exercise general corporate powers. Among its specific duties are the appointing of a State actuary and a State medical director. Their duties are clearly implied by their titles. The salaries of these two officials and their assistants are to be paid by the Commonwealth. The actuary is charged with the duty of providing standard forms of policies and contracts, blanks, record books and the like to be furnished free of expense to savings-bank insurance departments. Thus the State is giving a certain amount of direct financial aid to the movement.

While the Whitman Savings Bank Insurance and Annuity Department has the honor of issuing the first policy under this act, the People's Savings Bank, of Brockton, of which ex-Governor Douglas is president, is a close second. We have before us sample policies of the latter named institution. These policies are three in number: One is a combined insurance and annuity policy; the second is a whole life policy, and the third is an endowment policy.

An insurance and annuity policy issued at the age of 25 requires a monthly premium of $1.30. This is payable until the insured reaches his 65th birthday. From that date until death an annuity of $100 is paid. In case the insured dies prior to his 65th birthday his beneficiary or estate receives the sum of $500 from the policy. A point of weakness in this policy would seem to lie in the fact, that if a man dies between his 64th and 65th birthday his estate will receive $500, while if he dies between his 65th and 66th birthdays he would have received $100, his first annuity payment, and his estate will receive nothing at all. We are informed, however, that this objection is common to most annuity policies. We are also informed by Robertson G. Hunter, Massachusetts State Actuary, to whom we are indebted for much of this information, that he is at present working on rates for policies which will provide that in case a man dies between the ages

of 65 and 70 there will be returned to his estate the difference between $500, the amount of the insurance, and the amount of annuity that has been paid to him. This insurance and annuity form of policy is popular with those who are directly interested in the movement, and is, so far as we know, the only opportunity offered to laboring men in this country to provide themselves with annuities.

The whole-life policy provides for a monthly premium of $1, beginning at the age of 25 and continuing to the age of 75, when all premiums cease. The amount of insurance is $500 payable at death.

The endowment policy requires a monthly premium of $1.12, beginning at the age of 25 years. The amount of insurance is $500 and is payable at the age of 65 years, or at prior death.

The savings that this form of insurance will show over industrial insurance as written by regular companies is at least 25 per cent. The following comparisons are between the amount of insurance that can be purchased, at various ages, for a weekly premium of 15 cents in an industrial company, and for a monthly premium of 65 cents in the savings bank. In each comparison the first and smaller amount is from the industrial company, and the second and larger amount is from the savings bank. For age 20 compare $285 with $377; for age 30 compare $213 with $283; for age 40 compare $153 with $205; for age 50 compare $102 with $138, and for age 60 compare $60 with $81. The advantage is with the savings bank, and this advantage should be clearly comprehended by the wage earner. There may be urged against the above comparison that the cost of collecting premiums weekly is greater than the cost of collecting premiums monthly. But the difference cannot be very great, and the comparisons that we have given are just. In fact, from our knowledge of the methods of industrial insurance companies we believe that the advantages of the savings-bank insurance over industrial insurance, in returns to the insured, are greater than the above comparisons show.

In regard to medical requirements, the rules prepared by the State medical director to govern the acceptability of applicants for savings-bank insurance seem to be more exhaustive than the medical examinations required by companies doing an industrial business, and somewhat less severe than the examinations required by companies doing an ordinary insurance business. The fees are moderate.

There is a commendable spirit of coöperation on the part of many employers in the State of Massachusetts with those who are directly responsible for this movement. This coöperation should mean much toward bringing success to the project. Employers can take steps to interest their employees and to aid them in taking out this insurance, by pointing out its advantages, by establishing local agencies and in other ways. A large department store in Boston has already applied for such an agency and is enthusiastic in its support. Factory mutual benefit associations and coöperative associations will find an excellent means of aiding their members by taking out a local agency. The furtherance of a project of this kind by employers is one of the best avenues for welfare work or industrial betterment work that we know of, for it is entirely free of any taint of paternalism or of personal advertisement.

We are heartily in favor of this movement and appeal to the wage earners of the State of Massachusetts to consider it carefully and to avail themselves of its privileges. It forms a means of saving your money for old age and for saving money to provide for the wants of your family in case of your death. It is as essential to save as it is to earn, and we doubt if any real investment can be offered to you where the amount invested is as safe and the interest or dividends as great as in savings-bank insurance. The ultimate success of this project now lies with you, the wage earners. You must take out this insurance in large enough quantities to carry the movement beyond the experimental stage. By so doing, you will not only gain a direct, personal and material advantage, but you will be aiding fellow wage earners in other States, for if this movement meets with the success that it deserves, other States will soon follow the example set by Massachusetts.

The Cost of Building

The *American Lumberman*, of Chicago, is doing a praiseworthy piece of work in collecting information regarding the reduced cost of building operations at the present time as compared with those prevailing before the panic of last October. These reports have been obtained from all sections of the country and they necessarily differ widely among themselves. Broadly the figures given for the reduction range between 10 and 40 per cent., the last figure coming from San Francisco where, of course, conditions are exceptional. Leaving out that city the highest figure named is 25 per cent.

Regardless of actual figures it is, of course, well known that both material and wages in the building trades have gone down during the existing depression and, as a result, building operations are now cheaper than before—according to the *American Lumberman* cheaper than at any time during the past five years.

The lesson drawn from this combination of circumstances by the *American Lumberman* is that now is the time for manufacturers and others to carry out extensions and enlargements with a material saving to their own pocketbooks and at the same time giving material assistance to the revival in business activities.

New Publications

PRACTICAL HYDRAULIC TABLES AND DIAGRAMS. By C. E. Housden. 105 4¾x7¼-inch pages, with eight illustrations and six pages of diagrams. Longmans, Green & Co., New York City. Price, $1.25.

This work is a compilation of tables, diagrams, explanations, and examples of application for use in computing the sizes of pipes, drains and sewers. They apply to surface drains as well as to underground sewerage systems. Many representative examples are worked out in detail and thus clearly show representative methods of using the tabulated and graphical data.

PRACTICAL EARTHWORK TABLES. By C. E. Housden. 49 4¾x7¼-inch pages, and nine illustrations. Longmans, Green & Co., New York City. Price, 90 cents.

There are twelve pages of tables arranged to facilitate the estimating of quantities of earthwork in banks, cuts, fills and the like on any gradient and with any size of top or bottom area and with any slope of side or of the natural ground. There are numerous pages of explanatory notes and diagrams to illustrate the use of the tables.

REINFORCED CONCRETE, A MANUAL OF PRACTICE. By Ernest McCullough. 125 5x8-inch pages, with 28 illustrations. Cement Era Publishing Company, Chicago. Price, $1.

This book is compiled from articles that have appeared, from time to time in the *Cement Era*. It is written for men who are not technically educated, and for that reason is free of theoretical discussion. Many formulas and equations are given, covering the various elements in the design of concrete members, but these equations are in their simplest and most usable form, with a clear definition of what each quantity entering into each equation really is. There are numerous tables and illustrations suggesting details of construction. The work fully lives up to its name. There are eight chapters, the titles of which are: Strength of Beams; Loads on Beams; Columns; Walls; Tanks and Footings; Design and Cost; Forms; Conduct of Work; Tools. Of these, the last three are especially good and show a close acquaintance with actual concrete construction on the part of the author. Chapter five on "Design and Cost" is disappointing; but very little information is given in regard to actual costs, and only a few factors are presented that can be of service in estimating. While, of course, the cost of materials and labor vary widely with location, still the experience of the author is such that we looked for a more helpful treatment of this all-important question in connection with reinforced concrete.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Special Cylinder Boring Machine

This machine is especially designed for boring the cylinder of any class of simple or compound engine and piston-valve chamber at one setting by using the vertical, longitudinal and transverse adjustments of the machine. After a cylinder has been planed it can be set on parallel strips on the table, and the high-pressure and low-pressure cylinders and valve chambers bored without resetting, insuring the alinement of the cylinders. The spindle of 50-point carbon steel 7 inches in diameter, is fitted with two splines for driving, and is accurately ground and fitted in sleeves. The sleeve in the main pedestal is used for driving the spindle by means of a phosphor-bronze worm wheel 41 inches in diameter and a hardened-steel worm, with roller-thrust bearing; the worm and worm wheel are incased and run in oil. The other sleeve is fitted into the outboard bearing, is keyed to the spindle and revolves with the spindle.

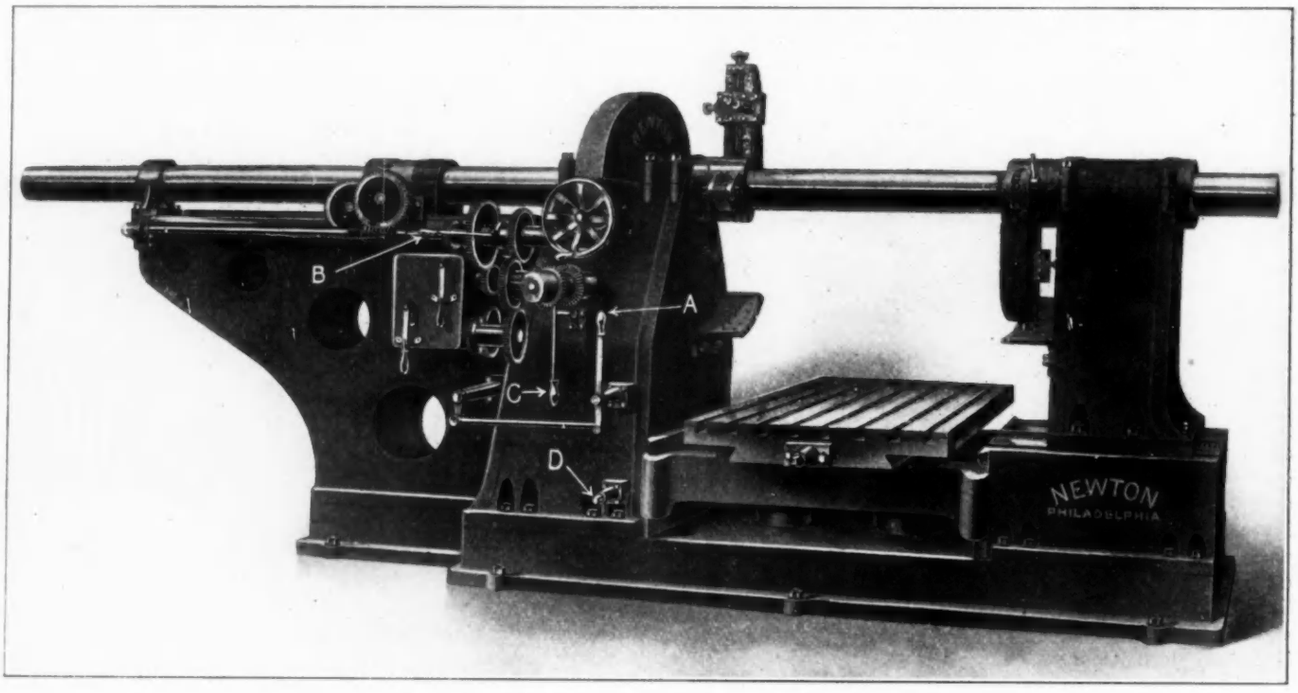
Both of these sleeves are lapped in the hole for the spindle so as to insure a proper bearing, and are ground on the outside and fitted in brass bushings which are accurately scraped, a cap bearing being provided for compensating for wear.

To each of these sleeves is fitted a special design of facing arm, which can be engaged or disengaged without stopping the spindle motion; on this facing arm is fitted a tool slide with in and out adjustment for setting the depth of cut; this tool slide has a feed in either direction on the arm, by means of star wheel and pins. The spindle is fed forward by a trolley operated by a screw and nut, and has a continuous motion of 140 inches, so that it can be entirely withdrawn for removing cylinders, without stopping to take a second grip on the bar.

Six changes of feed in either direction are supplied to the spindle amounting to 1/16, 1/10, 1/6, ⅓, ⅔, and 1 inch per revolution of spindle, and quick power motion in either direction is supplied at the rate of 10 feet per minute; the spindle having a speed range of from 4 to 15 revolutions per minute, and is operated either by a four-step cone or 20-horse-power 3 to 1 variable-speed motor. There is a clutched drive so that the spindle can be started and stopped without stopping the motor or countershaft. A fly-wheel is attached to the motor to overcome the shock of engaging and disengaging the clutch.

The outboard bearing is adjustable by means of a rack and pinion, to give a minimum distance between the facing arms of 45 and a maximum distance of 60 inches.

The cross-adjusting table is fitted with steel plates on the top, which gives a steel wing to the T-slots, prevents the T-slots from breaking out, and maintains the alinement of the top of the table. This table has hand or power adjustment, or both, as desired, and is adjustable longitudinally on the knee in order to bring different lengths of cylinders central between the facing arms.



SPECIAL CYLINDER AND VALVE-CHAMBER BORING MACHINE

The knee is accurately fitted between the bed, and is supported by four screws each 6 inches in diameter, which are used to raise and lower the table, and properly support the table to give a minimum distance from center of spindle to top of table of 43 and a maximum distance of 51 inches. The table is raised and lowered by power with a fine hand adjustment.

Referring to the illustration, lever *A* is used for starting and stopping the spindle motion, *B* when moved toward feed box engages the feed, and when moved toward the hand-wheel it engages the quick traverse, both of these movements being reversed by *C*. Hand adjustment to table vertically is accomplished by a ratchet through shaft *D*, and a lever, not shown, is used for raising and lowering the table by power.

Where inclined cylinders are used, as on some railroads, an auxiliary table is furnished which can be swiveled to bore at an angle of 20 degrees without requiring an additional setting. This is made by the Newton Machine Tool Works, Inc., Philadelphia.

New Model Roney Mechanical Stoker

The Westinghouse Machine Company, East Pittsburg, Penn., has designed a new model of the Roney mechanical stoker. Some of the most important features in connection with its design is that the number of complete grate bars has been reduced one-half over that used with the old type of stoker. The tops, webs, guards and dumping grates are interchangeable. The grate bars automatically center themselves in the side bearings by their own weight; they may also be re-distributed so as to equalize wear over all parts of the furnace. The guard and dumping grates are interchangeable without disturbing the side or center bearings. Fig. 1 shows the stoker as it appears in a furnace setting.

As will be seen from Fig. 2, the grate proper consists of a number of thin plates

FIG. 2. SOME OF THE DETAILS OF CONSTRUCTION

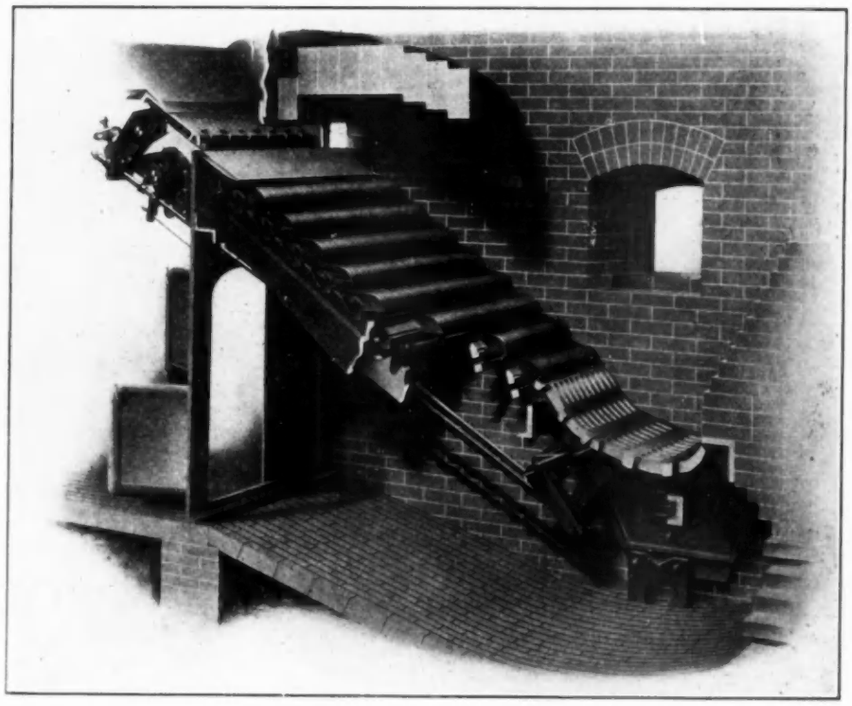


FIG. 1. NEW MODEL RONEY STOKER IN PLACE

set on edge in V-grooves. These hook over a trussed web, and are held in place by a key-rod slipped in from the end. They are, therefore, easily removed. One of the principal advantages of the sectional grate-bar tops is that it reduces the amount of scrap when they have been sufficiently worn to be discarded. No bolts are used, and any part can be removed without disturbing the other.

The new type of guard prevents the fire from sliding into the ash-pit when the dumping grate is operated. As the lower end of the guard is now raised, instead of cutting through the fire, as formerly, it not only makes it possible to dislodge from the fire all clinker formed at the bottom, but also provides an unobstructed descent for the ash and clinker separately. When dropped to its normal position, it permits the lower edge of the fire to settle quietly without a tendency to slide. The new dumping grate is hinged about one-third forward, dumping both front and rear and being nearly balanced, it is very easily operated.

The air supply to effect the combustion of volatile hydrocarbons is admitted through two wind-gates located on either side of the stoker. It first passes to the rear of the fire-brick arch, extending across the front of the furnace, and is then directed by baffles to the crown of the arch, at which point it enters the front air spaces. From the latter, it enters the furnace through the spaces between the stoker front and the first ring of arch brick. Passing the air over the furnace in this manner not only pre-heats the air, but assists materially in cooling the arch.

Following is a record of seven months' wear of the type *D* sectional grate-bar top:

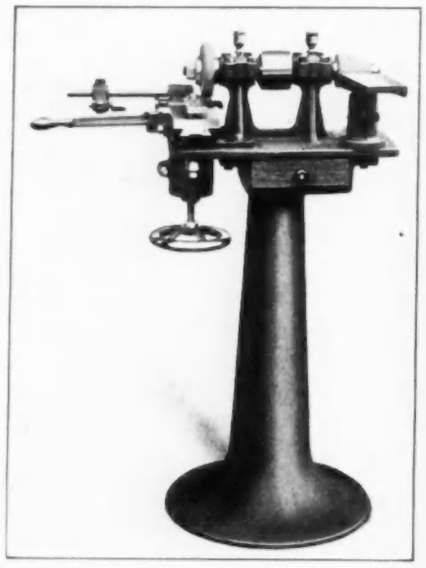
Sample No.	Weight, Pounds.	*Reduction, Per Cent.		Annual Depreciation, Per Cent.	Approximate Life, Years.
		In Weight.	In Burning Surface.		
1	2.375	17.4	38.7	66.3	1.51
2	2.625	8.7	23.7	40.6	2.46
3	2.625	8.7	16.7	28.6	3.49
4	2.75	4.3	11.3	19.4	5.16
5	2.562	10.9	10.0	17.1	5.83
6	2.69	6.4	7.4	12.7	7.88
7	2.562	10.9	4.8	8.2	12.1
8	2.812	2.1	3.2	5.5	18.2

*Weight of original top, 2.875 pounds.

An average annual depreciation of about 17 per cent. is shown by these eight samples, indicating a probable life of about six years, if the bars are re-distributed from time to time. In the upper part of the furnace, however, the wear was practically *nil*. With the grates open a maximum width, the effective admission area of the entire gate is 36.8 per cent. of the project area of the furnace. At maximum opening, i.e., in their lower position, the effective opening is 24.2. Taking the actual time of opening and closing, the average effective draft area of this type of stoker is 27.4 per cent. of the total projected area, as compared with an average of 17.9 per cent. with flat, horizontal fire tops. This increased admission area makes it possible to maintain a higher rate of combustion.

Grinder for Pipe Die

Many pipe threads are poorly cut owing to improper grinding of the dies, this being particularly true of steel pipes. In order to make it easy to grind pipe dies properly, the Bignall & Keeler Manufacturing Company, Edwardsville, Ill., have brought out the grinder shown herewith. This carries a specially formed wheel on one end of the spindle, and a platen is provided beneath the wheel on which the die is clamped. It is then moved back and forth under the wheel by the lever shown and at the same time is gradually raised by the hand-wheel, shown underneath. A gage is provided on the platen and the die placed against this which can be adjusted to any angle so that straight or taper pipe dies can be ground.



GRINDER FOR PIPE DIES

The shape of the wheel gives the dies the correct angle of rate and a wheel templet is furnished to assist in dressing the wheel to this shape whenever necessary. A dresser is also provided for this purpose.

The cone-shaped wheel on the other end is for grinding the lead of the die. The machine can be used for regular grinding by substituting any shaped wheel desired.

Exhaust System for Dry Grinders

The unpleasant feature of many grinding rooms is the dust that it seems difficult to avoid in most cases unless we can resort to wet grinding, which is not always possible. To do away with the annoyance of the dust, as well as its effect on the machine itself, the Walker Grinder Company, Worcester, Mass., has ar-

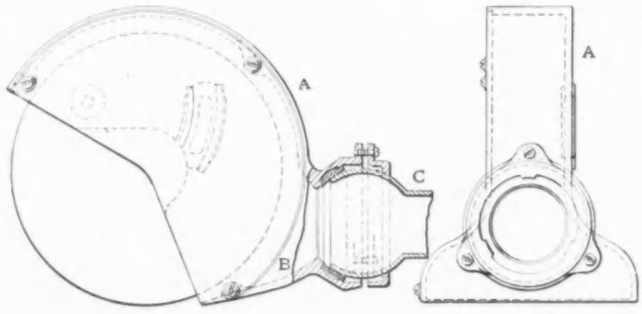


FIG. 2. DUST-EXHAUSTER HOOD FOR SURFACE GRINDER

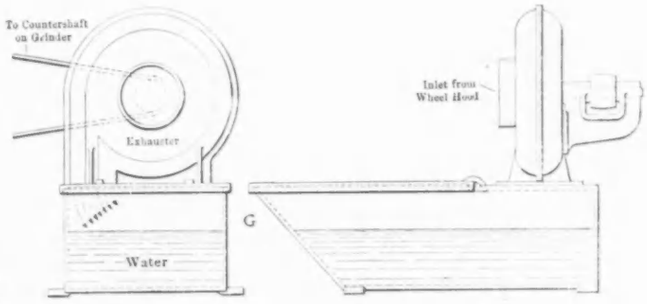


FIG. 3. DUST RECEPTACLE FOR SURFACE GRINDER

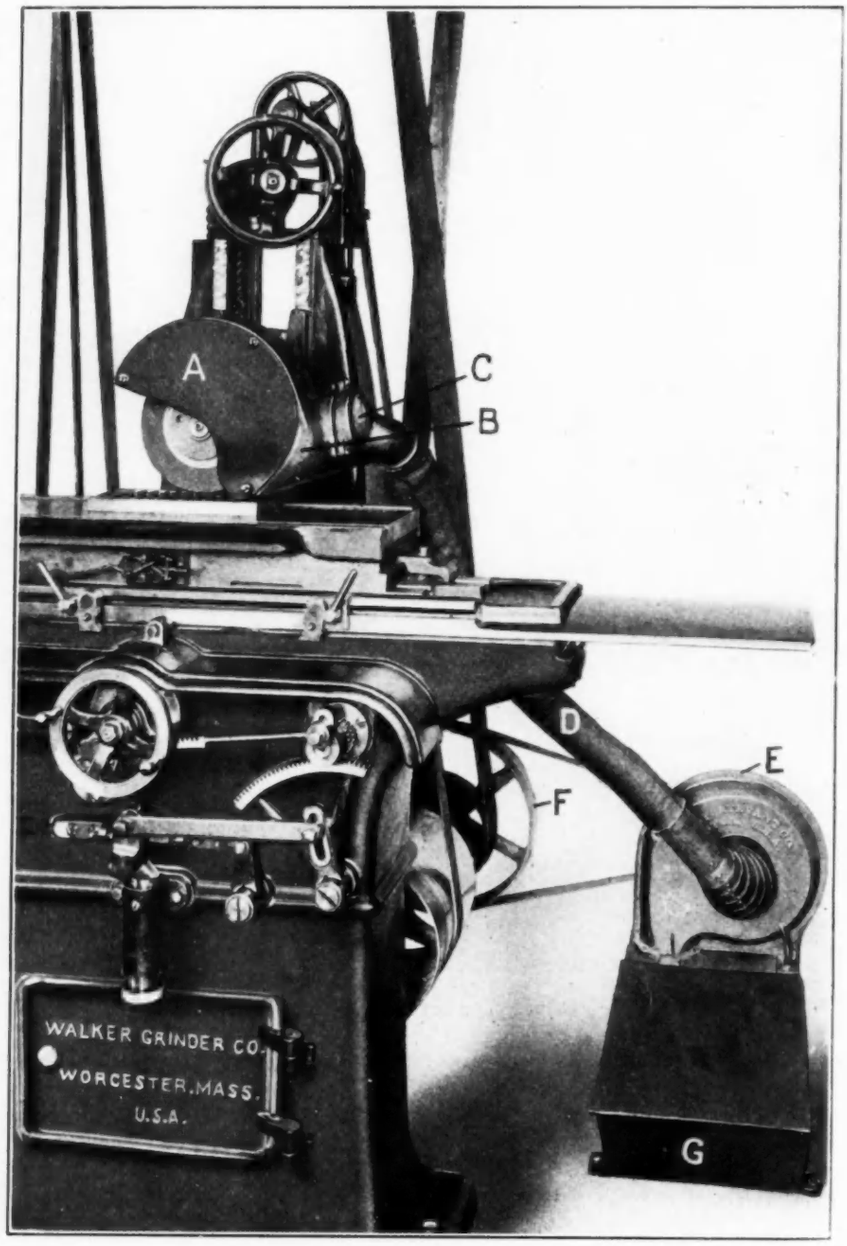


FIG. 1. EXHAUST SYSTEM FOR DRY GRINDER

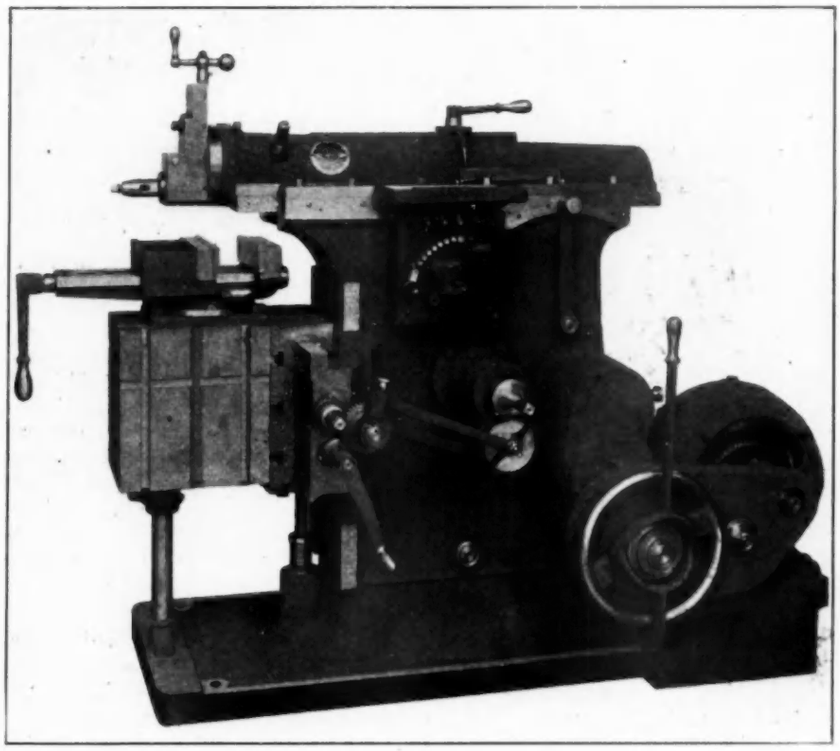


FIG. 1. ROCKFORD SHAPER WITH GEAR BOX

Geared Drive for Shaper

The manner in which the geared drive has been applied to the shaper of the Rockford Machine Tool Company, Rockford, Ill., is shown herewith, Fig. 1 showing the general appearance and Fig. 2 the details of the gearing. Fig. 1 shows a motor mounted behind the shaper, but the same gearing is also used with a single pulley for a belt, either in place of the clutch or in addition to it. The clutch enables either the motor or the belt pulley to be thrown in or out and so control the motor independent of the driving power.

Referring to the details in Fig. 2, the lower or power shaft *F*, carries the two gears shown, under control of a spring key. The large gear is driving the gear above it on shaft *H*, the other pair running idle. At the right of shaft *H* is a sleeve *G* carrying four gears and controlled by arm *A* through levers *B*, *C* and *D*. These four gears can engage any of the gears *J*, *K*, *L* or *M*, according to the position of the handle *D*. Four changes are obtained in this way and by moving the spring key into the other gear, by means of handle *I*, we have four more speeds, or eight in all. The motor is a 2-horse-power constant-speed Northern.

ranged an exhaust system to be applied to surface or other dry-grinding machines as illustrated herewith.

As shown, *G* is an iron receptacle on which is mounted the exhauster *E* with a down discharge into the water it contains. This receptacle *G* is intended to have a hinged lid and to be flared toward the front, so that the grit collected therein may be removed with a shovel. The exhauster *E* is driven by a belt from the pulley *F* attached to the end of the drum shaft on the lower part of the surface grinder, this drum shaft being a portion of the regular machine, extended for the purpose of mounting the pulley *F* beyond the bearing.

The tool *B* has a flaring mouthpiece about 6 or 8 inches wide, brought down to a knife edge, so that when adjusted it will just clear the top surface of the piece to be ground. The cover *A* makes a partially closed chamber around the grinding wheel, and the suction from the blower *E* through the flexible hose *D*, which has ball-joint connection *C* with the hood, removes the greater part of the dust from the grinding, and the little that escapes around and under the hood is found to be negligible and does not contaminate the air in the grinding room. The hood *B* swings on a pivot in the back, so that it can be adjusted to suit the wear of the wheel, the wheel shown in the illustration being about one-half worn out.

Figs. 2 and 3 show the details of the exhaust hood and the water pan for collecting the dust, and will make the construction and operation perfectly clear.

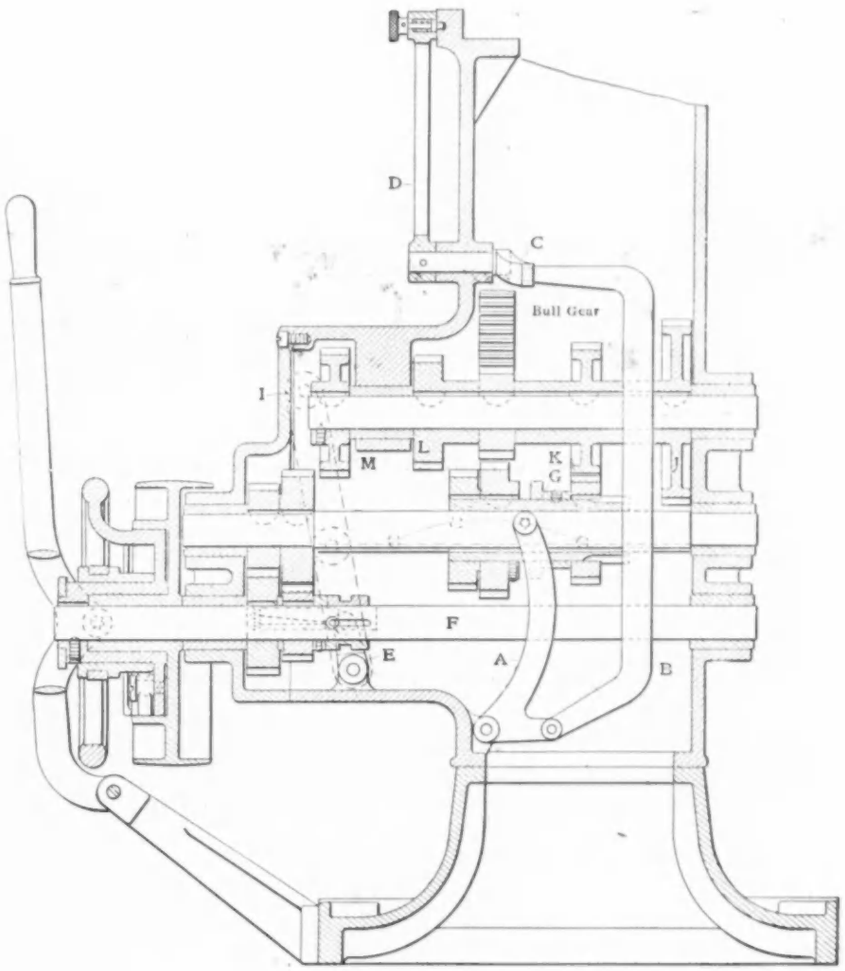


FIG. 2. SECTION THROUGH SHAPER GEARING

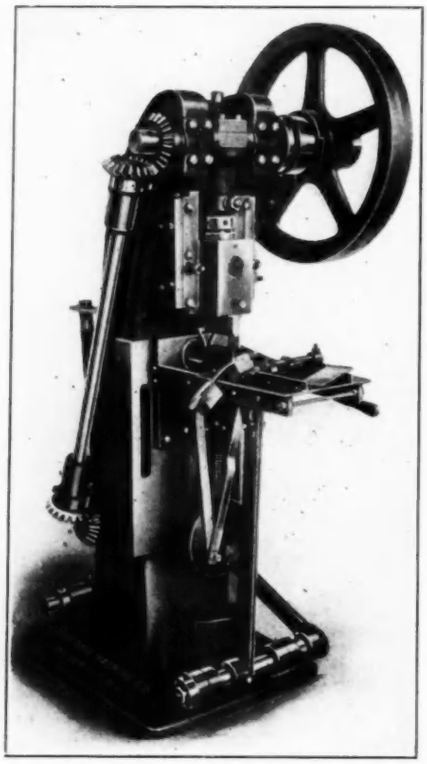
Grinding Machine with Gap in Bed

This machine was made for a German railway shop for grinding crank-pins, valves-stems, axles and extension piston rods so that the gap is made in the center but can be located at any point. A base is arranged for holding the steady rests so they can be moved along the front edge of the gap as desired, or they can be entirely removed.

The footstock is arranged for delicate adjustment to readily secure straight work and both head and footstocks are extra heavy for durability and accuracy.

The motor is so applied that no extra floor space is needed. The machine will utilize from 5 to 20 horse-power according to the work to be done and the ambition of the operator, the maximum only being necessary when very large and heavy work is being done.

This machine is known as a 20 and 32 by 168-inch self-contained electric-drive grinder, swinging 32 inches in the gap and 20 inches elsewhere. It takes 168 inches between centers and 44 inches in the gap. The total weight is 25,000 pounds and it measures 22 feet over all. The plates shown on the floor should be bedded in the foundation so as to be level and in line. These have wedges which can be adjusted by a nut on each side of the raised end and operate on threaded studs fixed in the base of the machine. Both plates and wedges are machined, insuring a broad and permanent contact. The wheels used are 24 inches in diameter by 4-inch face. The machine is built by the Norton Grinding Company, Worcester, Mass.



PRESS FOR LOCKING SEAMS

A Press for Lock Seams

The object of the makers of this press has been to avoid all complication possible and make it very simple, at the same time preserving the efficiency in every way. This press will handle body blanks for round, square or irregular shaped can bodies and make a perfect lock seam in every case.

The blanks are fed automatically and the completed bodies thrown out at the rate of from 45 to 60 can bodies per minute, according to the size of the can. The feeding, forming and locking are entirely automatic. It is made by the Max Ams Machine Company, Mount Vernon, N. Y.

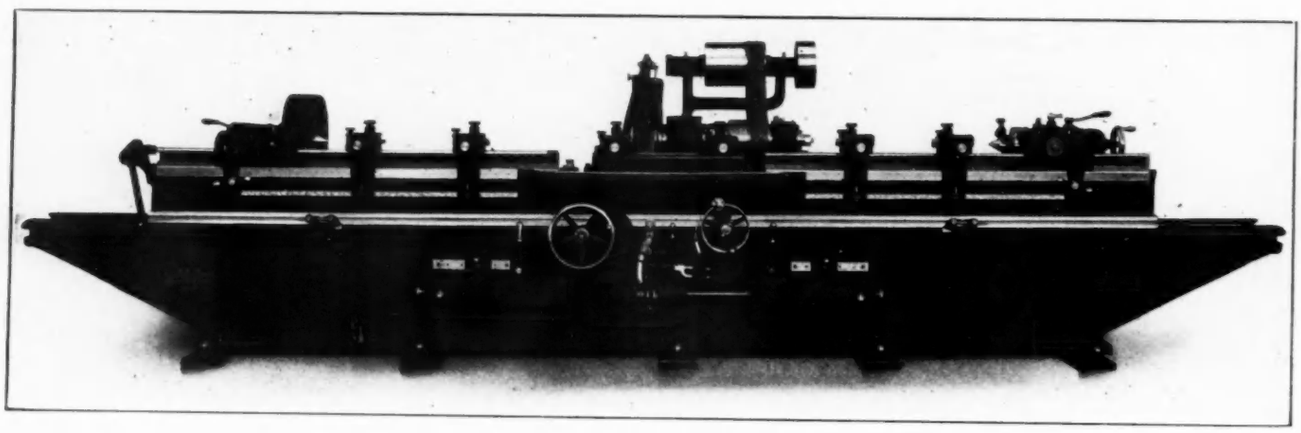


FIG. 1. FRONT VIEW OF 20X32X168-INCH SELF-CONTAINED GRINDING MACHINE.

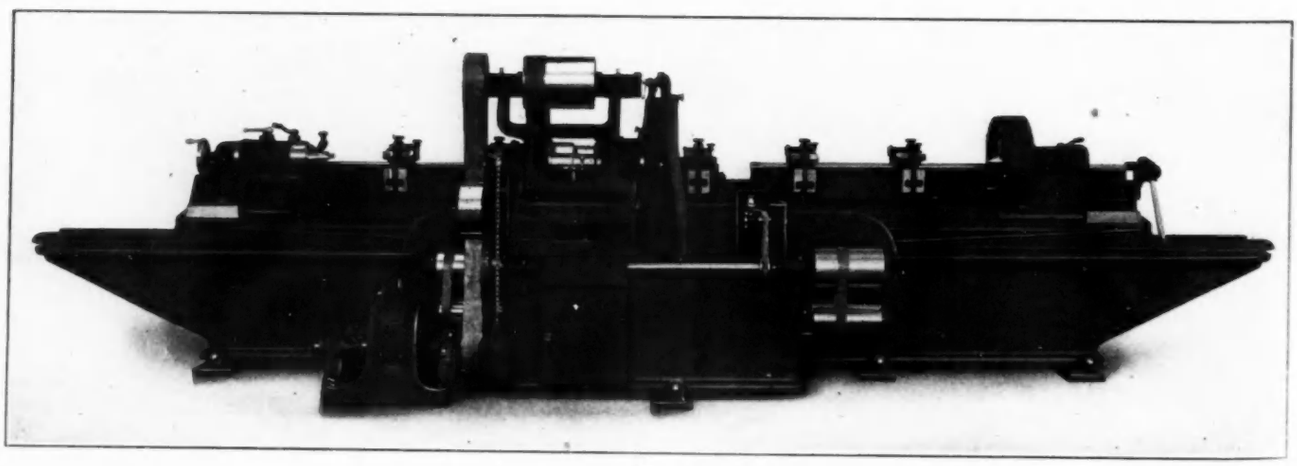


FIG. 2. REAR VIEW OF SELF-CONTAINED GRINDING MACHINE

Ryerson Portable Automatic Key-seating Machine

This Ryerson Portable automatic key-seating machine is designed for automatically cutting key-ways in locomotive axles either before or after the engine is assembled. The advantages of a machine of this kind will at once be apparent to every mechanical man who is acquainted with the difficulties encountered in locating and cutting key-seats for the eccentrics.

The machine illustrated cuts the key-way in a small part of the time required by other methods. In addition to the saving of time, the work done by the machine is practically perfect and standard in size.

The use of the machine avoids all possibility of the key-seat in the axle and eccentric not corresponding, which is often the case when key-ways are cut before the wheels are pressed on the axle. For repair work where the old driving axle is retained, it frequently happens that the key-way in the eccentric and the axle do not correspond. This contingency is, at the present time, overcome by the use of an offset key. The Ryerson portable key-seater can be used for recutting the old key-way in the axle to correspond with the eccentric, thus obviating the necessity of using an offset key with its correspondingly weakened construction.

The machine is so designed that it will cut as close as 1 inch from the driving box, while on the other hand the adjustment is such that any standard size key-way can be cut, and the cutting is done within the base of the machine, thus making the machine compact and permitting its use for eccentric cutting on axles where the distance between the eccentrics is very limited. The base of the machine which fits on the axle is 8½ inches long over all.

The machine is operated by an air drill or electric motor, as the illustration shows, the motor being simply connected to the machine by means of a taper shank, which is part of the machine. The motor should operate at between 300 and 450 revolutions per minute. Both the vertical and horizontal feed of the machine is entirely automatic so that no attention is required beyond the placing of the tool in position. The machine weighs approximately 100 pounds. It can be operated in any position on the axle, and the work done is practically perfect.

The machine can be used for key-seating axles for driving wheels, cutting key-ways in shafts, etc., and is handled exclusively by Joseph T. Ryerson & Son, Chicago, Ill.

An Electrically Driven Portable Radial Drill

This is a new type of electrically driven portable radial drill recently brought out by the United States Electrical Tool Company, Cincinnati, Ohio. Both the vertical column and horizontal arm are made of steel tubing, while the motor is mounted directly on the drill spindle, and is raised and lowered with it through its range of 5 inches. It has a worm feed by hand, and also a quick return by dropping the gear out of mesh and using a small crank on the other side of the horizontal arm. This arm is moved in and out from the column by rack and pinion, while the vertical movement is by the screw shown.

The arm can be extended to drill at a radius of 32 inches, and can also be swiveled so as to drill at any desired angle. A setting line enables it to be brought back to the vertical position without the use of a square. An eye-bolt is provided so that it can be easily handled by a crane, or two can put a bar through this eye and carry it to any part of the shop, as it only weighs 160 pounds. The switch is inclosed and the drill is started and stopped by simply pulling out the switch lever. The hand-wheel at the top is for forcing out drills, the spindle being

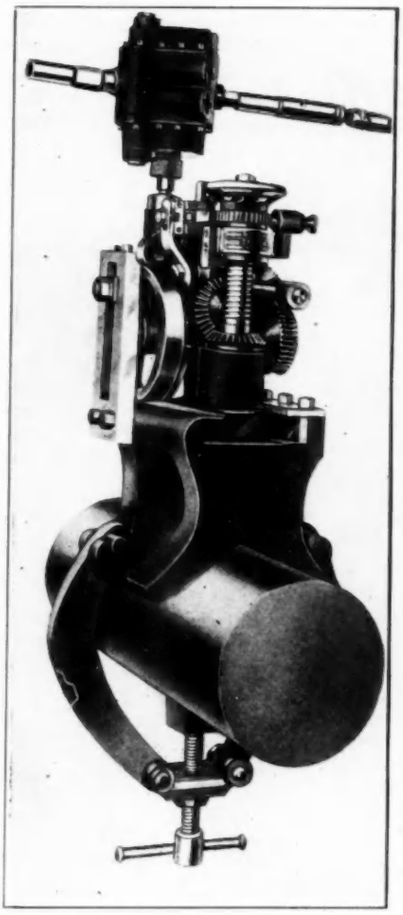


FIG. 1. FRONT VIEW OF RYERSON KEY-SEATER

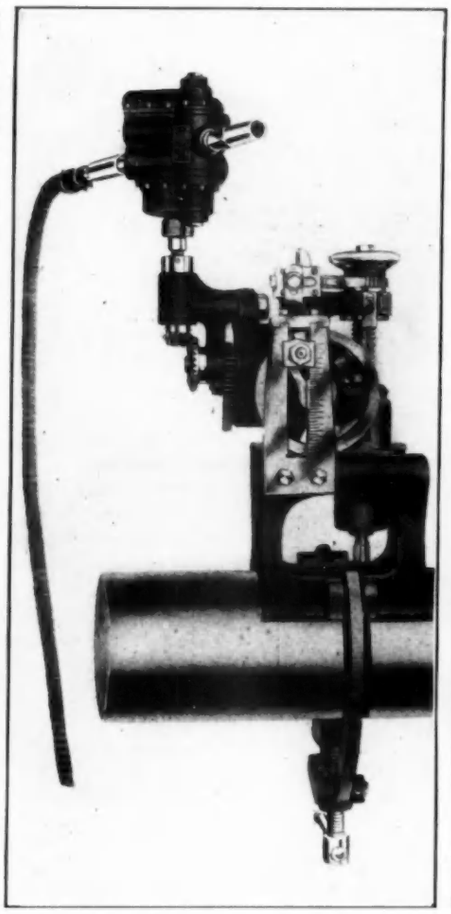


FIG. 2. VIEW OF LEFT SIDE OF KEY-SEATER

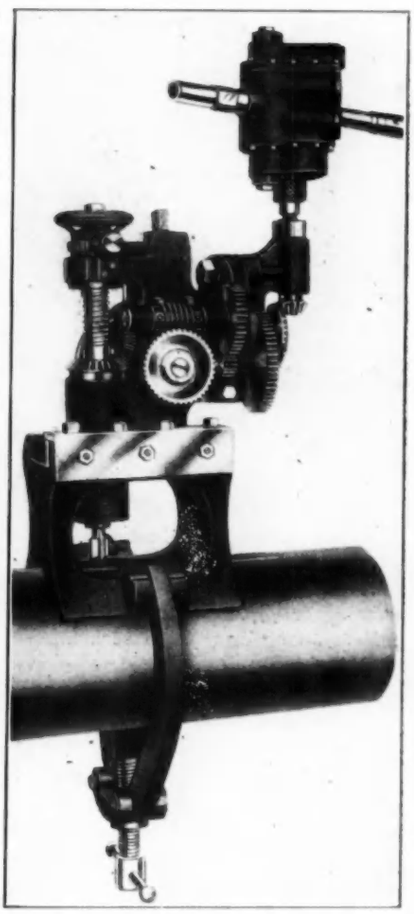
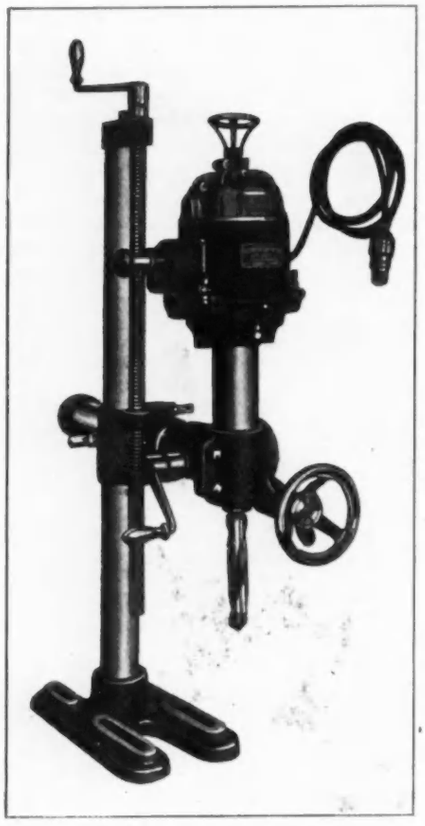


FIG. 3. VIEW OF RIGHT SIDE OF KEY-SEATER

fitted with a No. 2 Morse taper for the ⅞-inch size, and a No. 3 taper for the 1¼-inch drill. The drills are fitted with ball thrust bearings on the spindle, and



ELECTRIC PORTABLE RADIAL DRILL

the motors can be furnished with either alternating or direct curent, and can be run from an ordinary lamp socket.

A Double Emery Grinder

The double emery grinder shown in the accompanying illustration is one of the latest machines brought out by Gisholt

A DOUBLE EMERY GRINDER

Machine Company, of Madison, Wis. This machine is inclosed as much as is possible with a grinder of this type and is supplied with a fan water pump and large water reservoir. The water nozzle, instead of being in the usual position on the upper side of the work rest, is in the back or on the wheel side of the work rest, thus the water instead of coming from a nozzle directly over the wheel and rest follows the wheel and comes around in a fine spray to the point of contact; thus the work is always in plain view. This method of water supply does away very largely with splashing. In addition, this machine has a water pan so flared on the sides and front that a piece of work up to 14 inches in length comes entirely within the pan and, therefore, any drip from it will go directly into the pan. The machine is supplied with two 1½-inch face by 14-inch diameter emery wheels, and may be supplied either for belt or motor drive.

The Safe Working Loads for Gear Teeth—Omission

In the article under the above title that appeared at page 114 the accompanying table was omitted.

FIG. 2. MULTIPLIERS FOR FACTOR "A." ACCORDING TO THE CONDITIONS OF SERVICE AND DESIRED LIFE OF GEARS.

Time of Service.	Uniform Lead.		
	Continuous.	10 Hours Daily.	5 Hours Daily.
For 3 months	3.00	8.00	18.00
For 6 months	1.50	4.00	9.00
For 9 months	1.00	2.67	6.00
For 1 year	0.75	2.00	4.50
For 2 years	0.38	1.00	2.25
For 3 years	0.25	0.67	1.50
For 4 years	0.19	0.50	1.13
For 5 years	0.15	0.40	0.90
For 6 years	0.13	0.33	0.75
For 7 years	0.11	0.29	0.65
For 8 years	0.10	0.25	0.56
For 9 years	0.09	0.22	0.50
For 10 years	0.08	0.20	0.45

For gears subjected to 25 per cent. overload multiply result by 0.80; for gears subjected to 50 per cent. overload multiply result by 0.70; for gears subjected to 75 per cent. overload multiply result by 0.60; for gears subjected to 100 per cent. overload multiply result by 0.50; for gears operating in dust-proof oil case, multiply result by 1.50.

A Chart for Belt Horse-power—Errata

The author of the article that appeared under the above title at page 972, Vol. 31, Part 1, calls attention to two errors in his original manuscript which should be rectified as follows:

In column "C" (area of cut cast iron) in chart accompanying the article, the sixth number, instead of reading 0.368, should be 0.036, and in the 19th line of the column of description at page 972 the per cent. of carbon in steel instead of reading 0.01 per cent., should be 0.1 per cent.

Trade Opportunities in South America

By W. de Moreira

My sojourn of four years in South America, traveling most of the time throughout Brazil, Argentina, and Chile, gathering data concerning commerce has proven to me that as a rule the American manufacturer does not know what a big field he will find there for his goods. English, German, French, Italian, and even Belgian manufacturers are aware of the commercial opportunities in these various republics and devote more attention to the South American market than the Americans themselves. The Japanese, the Yankee traders of the Far East, understand this so well that, aided by their government, they have established a steamship line which runs from Japan to Chile, and have arranged a postal money-order exchange between the two countries.

How is it that the American manufacturer, who is generally so keen regarding commerce, is lagging in the rear and letting other nations have nearly a free control over this Golconda? This question is hard to answer without hurting somewhat our pride, but bluntness, I think, will be more appreciated than an apologetic statement. The truth is that we are very ignorant regarding South America. We hardly know the geographical location of the different republics, their languages, their means of transportation, their banking systems, etc.

A few years ago while getting ready to start on my journey to Brazil, a gentleman from Boston asked me to send him some data regarding the rubber industry in Para. Before leaving his office he said to me, "I have a friend somewhere in Brazil who could furnish me all these details, as he has a large rubber plantation; unfortunately, I have lost his address." When I asked him if that friend of his was living in the State of Para, he answered that he was positive his friend did not live there, in fact he knew he lived in the State of Yucatan, but could not remember the name of the town. Yucatan is a State of Mexico, some 6000 miles from Para, which is in the northern part of Brazil. I have had many people show me their astonishment and sometimes their disbelief when I told them that Portuguese was spoken in Brazil. Some thought Spanish was the language, some even thought it was English and an Illinois manufacturer told me it was "dago."

The Small Amount of Our South American Trade

The American manufacturer will understand quickly enough the value of commercial opportunities in South America, when he knows that the foreign trade there during 1907 amounted to $1,51[illegible]

415,000, of which the share of the United States was only $233,293,300, including both exports and imports, or barely one-seventh. Going more into details he will see that South America sold us products to the value of $147,680,000, and bought from us only $85,612,400, leaving a balance against us of practically $60,000,000. Is not this the best of proof of my assertion that the American manufacturers are lagging behind other countries in their exports to South America?

There is no doubt, however, that we have improved our exporting in the last 10 years. The figures which I will give, and which were obtained from the report of the Bureau of the American Republics ought to be an incentive to the manufacturer and also a proof that there is a good field for him there. The entire commerce, exports and imports, between the United States and the countries to the south of her, amounted in 1897 to $252,427,798. Three years later, in 1900, this had grown to $324,680,368. In 1905 it had expanded to $517,477,368; in 1907 it had reached the total of $587,194,945. Thus in 10 years our trade has increased by the vast sum of $335,000,000, or more than double.

Some Countries are Very Progressive

The scope of this article does not permit me to treat at length of the greatness and importance of various countries of South America. I must, however, say a few words on Brazil, a country so large, so full of resources, so great in openings, that one finds it hard to believe that such a country possesses so many opportunities. If the manufacturer knows that the entire area of the United States could be placed inside the limits of Brazil, and that there would be still room for Germany, that Rio de Janeiro is a city of over 1,000,000 inhabitants, that all over Brazil there is evidence of progress, that railroads are being built, harbor and rivers are being improved, factories are being erected, he will readily believe that no country in South America furnishes him with more chances to build up his trade.

Uruguay and Paraguay are small, but progressive. One is improving its harbor, the other its river and rail service in order to be in touch with its neighbors, Argentina and Brazil. Argentina is a very progressive republic and possesses a perfect railroad system. It is enough to say that her foreign trade during 1907 shows a total value of $582,065,052 gold, covering imports worth $285,860,683 and exports $296,204,369. Chile, wealthy through its nitrate fields, has also a great future and its government is preparing to spend $10,000,000 for harbor and dockage facilities, and will thus make the most complete port on the Pacific ocean.

All these countries, Bolivia, Peru and Ecuador need machinery, tools, engines, mining and electrical apparatus, etc. All these countries will, I am sure, buy much of their goods from American manufacturers if they only know about them; but as a rule they don't.

American manufacturers have a great object lesson in the Germans, who, manufacturing in many instances goods of a quality inferior to ours, have, nevertheless, "the cream" of the exports in South America, because they cater to the public in an intelligent manner.

Know That Your Salesmen Speak the Language of the Country

An American thinks he can do business in South America as he does in Chicago; he is greatly mistaken. If you wish to succeed in the South American market send somebody there who can speak Spanish and Portuguese, not somebody who says he can, but someone you are positive knows the language. I have met in Rio an American salesman who did not speak one word of either Spanish and Portuguese, but who, having told his firm in New York that he knew these languages well, was taken at his word with the result that not being able to carry out his bluff returned home with more of an expense account than results warranted, while the orders he sent to his firm were obtained mostly through charity and good fellowship of a few Americans residing there.

Though a salesman may be of the best here, it does not mean he will be so there. An aggressive, breezy man will succeed in Chicago and may fail in Boston. A salesman in South America, to be a success for his firm, must unite business knowledge with diplomatic tact, sharp trade acumen with suave manners. He must have his literature written in Spanish and Portuguese; English is not understood. Of what good would it be to the American manufacturer to receive a catalog in Chinese or Japanese? He might keep it as a curiosity, but he would not understand it. Your catalog printed in English has not even the merit of being a "curio" there.

Be Careful in Filling Orders and Packing

But there is another reason why the American manufacturer does not succeed in his South American export and that is his independence in filling an order received from a foreign country. It would seem rational that he would be only too glad to fill the order according to instructions; however, this is not so, and the unfortunate methods of conducting business followed by a large number of American manufacturers are bringing every day disastrous results. I know of the case of a South American house who wrote to an automobile firm in New York for quotations on automobiles. The quotations were given and the firm ordered six machines of 25 horse-power each. The American firm shipped six machines of 30 horse-power, writing that it did not have the machines of 25 horse-power and billing the machines at the increased price. They were, so I understand, refused, causing a loss to the shipper as well as to the buyer, making him, moreover, disgusted with the methods of that firm. The same experience happens daily in regard to packing. I have seen machinery, which, on arrival had to be refused on account of not having been packed according to instructions; naturally the buyer did not wish to expend his profit in repacking it for narrow-gage railroad and mountain transportation.

As soon as the American manufacturers will appreciate the difference between conditions they prepare for in shipments in the United States and those to be prepared for in transoceanic shipments they will progress rapidly in the export business.

South American Credit

Another stumbling block for the South American export is that the American manufacturer still clings to his own ideas of credits and is losing business right along by reason of it. The need of American banks in South America is becoming a daily necessity and one cannot but wonder why the American people have delayed so long from establishing banks of their own in the various South American republics. The Germans, the English and even the French have understood the immense advantage of helping their trade by having banks of their own. In this manner they safeguard their interest, as far as credits are concerned, and they obtain most valuable inside information as to the general trade conditions and financial conditions of business houses. A point to be noted is that actually all banking profits resulting from commercial operations between South America and the United States benefit corporations foreign to the United States. That such profits are very considerable is evident by a study of the different bank statements. I personally know that the yearly profits of a foreign bank in a town in Chile where there are six other foreign banks is nearly 60 per cent. on the capital stock.

London is a great factor in the bank transactions in South America. Remittances are always arranged through London. In other words, if a South American buyer must send money to New York he buys from a banker there a draft on a banker in New York. The price of this draft is subject to two conditions: the rate of exchange between that country and London, and between New York and London. Once the draft is issued, some London banker is credited with the amount; this amount is drawn on him by the New York banker when the draft is paid in New York. The opening of an American bank in South America would force the settlement to be made direct between New York and these banks

and the profits obtained therefrom would be considerable.

The establishment of American banks would also facilitate credit, though nowadays the South American buyers do not require such a long credit as formerly; commercial paper is discounted now by the banks, thus enabling the purchasers to buy for cash or on short credits. The present general method of credit in South America is to buy at 90 or 120 days with interest of 10 per cent. from date of invoice. The jobbers who thus purchase sell to the retailers on 60 days' credit. The retailers sell for cash. Thus the lack of capital is well assisted by a good credit system.

It seems to me that the American manufacturer could make some arrangement with some English banks which have agencies in South America as well as in New York to transact their business and to furnish them all the information regarding the credit and standing of commercial houses there.

Ships to South America

There is another point which the manufacturer is not well aware of, that is the transportation facilities between New York and the various republics of South America. They say we have no mercantile marine and, therefore, we are obliged to send our goods to England and have them transhipped. It is certainly sad to see every day ships entering the southern harbors flying the English, German, French, Austrian, Italian and Spanish flag and only once in a while some small sailing vessels flying the stars and stripes. It does not behoove me, however, to create an argument for subsidy. No doubt the time is near when the American will realize the necessity of having a good merchant marine; meanwhile they should realize which is the best way to send their merchandise.

Some manufacturers were complaining to me some time ago that it was too bad that only one ship sailed monthly from New York to Brazil, and were much astonished to hear that they could ship their goods direct every week if they so desired. As a matter of fact there are nine sailings from New York a month to Buenos Ayres, about seven for the South of Brazil and as many more for the north; four to Chile, via the Straits of Magellan and 12 via Panama with transhipment at Colon.

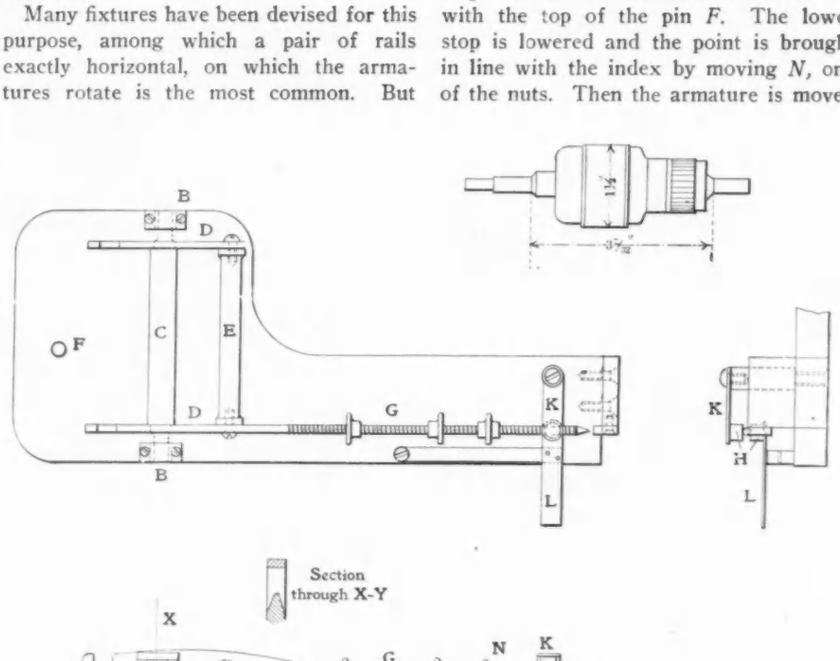
There is no doubt, however, that a well established line of American steamers running weekly or fortnightly to South American ports with prompt and well kept schedules will be of immense value to establish confidence and to augment trade between the two Americas. The manufacturer has all the opportunity to ship his goods direct, the only thing of vital necessity for him to remember is that the countries there are not like the United States, that the means of local transportation are not as perfect as ours and that, therefore, he must pack his goods well and ship them according to instructions.

A Balancing Fixture for Small Armatures

By P. Fenaux

In electrical construction one of the most important points is to obtain a perfect balance of the rotating parts; the smallest unbalanced weight produces vibrations.

Many fixtures have been devised for this purpose, among which a pair of rails exactly horizontal, on which the armatures rotate is the most common. But for small armatures the least amount of vibration in the building interferes with the indication of the rails. The fixture here shown has been made for the armatures of electrically driven phonographs. To balance such armatures, the only way is to drill enough holes between the slots on the outside of the disks to compensate for the weight in excess on the other side.



A BALANCING FIXTURE FOR SMALL ARMATURES

This fixture is composed of a cast-iron base *A* with two supports *B* for the axle *C* of the moving part. These two supports are made of hardened tool steel and of such a shape that the knives of *C* bear only on two points. The balancing part is formed of two flanges *D*, connected by *C* and the counterweight *E*. This counterweight is made so that it will balance the armature of smallest weight. The armature is placed in the notches of the flanges, the pin *F* is used for noting the position when balancing. One of the flanges is lengthened by a rod, threaded and ended by a point. This point comes in front of an index fixed on the plate *A*. Toward the end, on each side of the rod *G* comes a small rubber stop *H*. The upper one is fixed on a rather stiff spring *K*; the lower one on a spring *L*, supported by a long spring *M*. On the rod are screwed three nuts.

The centers of the armature and of *D* are above the edges of the knives, thus bringing the center of gravity of the system above the points of support, so that the smallest difference on one side or the other will produce a large movement of the point of *G*. The armature to be balanced is put in the notches with a slot in line with the top of the pin *F*. The lower stop is lowered and the point is brought in line with the index by moving *N*, one of the nuts. Then the armature is moved half a turn. If in this new position the point has a tendency to go under the index, that means that the side of the armature next the pin is too light, and the side first placed there is to be drilled. Leaving the nut *N* as it is, one of the two others is moved, so as to bring the point again in line with the index, and this movement indicates, by comparison, to what depth the hole or holes must be drilled. If instead of coming down the point had pushed against the spring *K*, the reverse operation would have been performed.

Though it takes quite a long time to explain the use of this balance, it does not take very long to get accustomed to the indication of the nuts. As the holes drilled are very small, about ⅛ inch, they are drilled with the armature in position on the fixture; the spring *K* withstands the pressure.

Cincinnati Outing

The third annual outing of the employees of the Cincinnati machinery manufacturers, representing the Cincinnati branch of the National Metal Trades Association was celebrated on Saturday, July 25, at Chester park, the usual ground for the event, and the affair turned out a genuine success.

A goodly number of employees were on hand with their families, and the day's program was carried out with a vim that left little to be desired. Entries for the athletic events, under the direction of M. C. Langnecker, of the gymnasium, and his assistants, were numerous, and the sport, with the award of prizes, was enjoyed by all hands. The grounds with all its forms of amusement were available to all ticket holders, and much credit is due E. H. Hargrave, of the Cincinnati Tool Company, chairman of the committee in charge of affairs, and his associates on the committee, P. O. Geier, of the Cincinnati Milling Machine Company, S. C. Schauer, Cincinnati Machine Tool Company, Robert McGowan, of the John H. McGowan Pump Company, E. Von Wyck, of the Von Wyck Machine Tool Company, and John Manley, secretary of the Cincinnati association. Dinner time found the club house well thronged with members, superintendents and foremen, for whom a special feast had been provided.

Personal*

L. Best, of Best & Co., New York City, sailed for Europe on July 16 and expects to remain abroad some weeks.

Henry Hess, president of the Hess-Bright Manufacturing Company, is expected back shortly from a several weeks' trip abroad.

Henry P. Corbin, the foreman machinist of the Moline Tool Company, has been elected instructor in shop practice in the new manual training school being built in Moline, Ill.

Lewis F. Moody, who has been connected with the hydraulic department of the I. P. Morris Company, has recently resigned in order to accept the position of assistant professor of mechanical engineering at the Rensselaer Polytechnic Institute.

Prof. G. I. Rockwood, who has occupied the chair of professor of steam engineering at the Worcester Polytechnic Institute, has resigned in order to give his entire attention to business connections. He is to be succeeded by Carleton A. Read, recently professor of mechanical engineering in the New Hampshire State College, and formerly connected with the engineering department of the Worcester Polytechnic Institute, of which he is a graduate.

*Items for this column are solicited.

Obituary

Carl Lunkenheimer, vice-president of the large Cincinnati firm of Lunkenheimer & Co., died on July 19, after a long period of ill health.

Charles H. Dale, president of the Peerless Rubber Manufacturing Company, and officer and director in many other rubber and mechanical-fabric manufacturing companies, died on July 18, after a brief illness. Mr. Dale was 56 years of age.

Business Items

The Sprague Electric Company has recently opened a branch office in the Colman building, Seattle, Wash., in charge of W. R. Hendrey.

The Mesta Machine Company, of Pittsburg, has opened an office in Chicago at 844 Commercial National Bank building, Lane Johnson in charge.

Thos. L. Dickinson, manufacturer of diamond tools and points, has purchased the business of the late John Dickinson, which has been carried on at 64 Nassau street since 1796.

Hanna Engineering Works, 820 Elston avenue, Chicago, Ill., has recently added to its line of riveters the entire riveting business of the Quincy, Manchester, Sargent Company, Plainfield, N. J.

The Westmacott Gas Furnace Company, of Providence, R. I., has been reorganized so as to enlarge the plant to take care of their growing business. In addition to manufacturing a full line of gas blast furnaces of all kinds, they will open a department for building all kinds of special furnaces to order. The officers are W. C. Buell, president and treasurer, and W. C. Buell, Jr., secretary and general manager.

Trade Catalogs

The Baush Machine Tool Company, Springfield, Mass. Circular illustrating and describing Bocorselski's turret tool holder.

Asbestos Protected Metal Company, Canton, Mass. Catalog of asbestos protected metal for roofing, siding and ceiling. Illustrated, 28 pages, 5x7½ inches, paper.

The B. F. Sturtevant Company, Hyde Park, Mass. Booklet entitled, "The Symbol of Durability," describing the metal-to-metal joints on the Sturtevant economizer. Illustrated, 8 pages, 3½x6 inches, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 4575 on oil break switches, Type F, Form K-7. Illustrated, 8 pages, 8x10½ inches. Bulletin No. 4596 describing inclosing globes for arc lamps. Illustrated, 4 pages, 8x10½ inches. Bulletin No. 4507, describing Thomson Astatic instruments for continuous current switchboards. Illustrated, 12 pages, 8x10½ inches. Circular No. 3664, illustrating and describing GE locking socket.

Business Opportunities

The Holland (Mich.) Furnace Company will double the size of its plant.

The Brooks Tire Machine Company, Wichita, Kans., will erect a new plant.

Charles Hagan, Winchester, Ky., will establish repair and machine shop.

The Eastern Can Company, Providence, R. I., will probably locate in Westerly.

The Springfield (Ohio) Metallic Casket Company is building a five-story addition.

The Galard Company, New York, recently incorporated, contemplates increasing its facilities for manufacturing its product, which is medicine cabinets, invalid trays, bath stools, high and low plush tanks, etc. The company is now negotiating for a large manufacturing building near New York and will be in the market for machinery and fittings.

The Isthmian Canal Commission, Washington, D. C., will receive bids until 10:30 a.m., August 10, for locomotive crane, derricks, turbo-generator, switchboard, electrical supplies, steel rivets, bolts, spikes, iron washers, copper gaskets, rail benders, tin-shop tools, track and post drills, wrenches, chisels, pouring ladles, bitts, hydraulic jacks, steam cocks, etc., as per Circular No. 456.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., August 17 for single-spindle universal horizontal boring machine, double-cylinder timber planer, matcher and jointer, 3-spindle vertical car-boring machine, pumps, jacks, truck springs, chain, twist drills, reamers, taps, milling cutters, drill chucks, saw blades, carborundum wheels, etc., as per Circular No. 457.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: August 4—Bolts and nuts (schedule 127), twist drills, brass hinges, nails, brass nuts, machine screws, wood screws, brass and copper wire, phosphor bronze wire (schedule 131), sheet brass, iron billet steel, tool steel (schedule 132), brass and iron pipes, fittings, (schedule 127), water-gage glasses, copper pipe, galvanized pipe (schedule 135).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: July 28—Hack-saw blades, corundum wheels (schedule 83), bolts and nuts (schedule 99), chain blocks, pipe cutters, pipe dies, twist drills, files, electric hoist, slitting saws, stocks and dies, pipe tongs, pipe wrenches (schedule 97). August 4—Upright drill, saw and dado machine, tenoning machine (schedule 102). August 11—Oil burner (schedule 111), motor (schedule 113), vertical triple plunger pump (schedule 89), gang drill (schedule 109), drilling and countersinking machine, splitting shear (schedule 112), tool grinder, traveling hoist, key seater, engine lathes, extension bed gap lathe, boring and turning machine, core box machine, drilling machine, pipe machine, gravity molder, crank shaper, shaper (schedule 113). August 25—Engine lathe, drill press, crank shaper schedule 108).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

High power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Table giving circumference of any diameter from ¼-inch to 80 inches mailed for 10 cents. Bell Odometer Works, Oakmont, Pa.

Wanted—One old style No. 13 B. & S. milling machine. First-class condition not absolutely necessary. Box 234, AMER. MACHINIST.

Wanted—Machinery or machine parts to build by contract. Ideas developed; drawings made. Address "A.," care AMER. MACH.

Wanted—An eyelet machine with 6 plungers. Must be in first-class condition. Address, stating particulars, "M. C. F.," care AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Drawings, designing, special and automatic machinery, inventors' ideas developed, by mechanical engineer of long experience. First-class references. H. W. Cole, 453 Third St., Brooklyn, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris streets, New York City.

Graduate mechanical engineer planning to return New York City to start business of manufacturer's agent in all mechanical lines, including railroad supplies, machinery, machine tools and general supplies, etc. Large experience in selling; now department manager large machinery house. Box 300, AMERICAN MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent, age 39, with many years' experience, is now at liberty to correspond with parties wishing to secure a man that can bring their production up to the standard, and without friction. Box 305, AMER. MACH.

FLORIDA

Position as superintendent or master mechanic. Up-to-date hustler, wide experience, good character and references. Address Box 316, AMERICAN MACHINIST.

ILLINOIS

Designer on machine tools and shop equipment. Box 325, AMERICAN MACHINIST.

Practical and technical man with experience designing presses, shears and dies for sheet metal and structural work. Control some new and valuable features. Box 328, AMER. MACH.

INDIANA

Foundry superintendent of great executive ability who thoroughly understands practically an iron foundry in all its departments and making one pay, is familiar with a great variety of castings in loam, dry and greensand mixing iron by analysis, economical cupola practice, wishes to hear from parties who can appreciate a man who can make money for them. Eighteen years superintendent and foreman. First-class references. Box 331, AMER. MACH.

MASSACHUSETTS

Expert designer and draftsman on special and automatic machinery; practical machinist; good technical education, twelve years' experience. A-1 references. Address Box 327, AMERICAN MACHINIST.

Superintendent, good executive, up on cost and production. Technical and practical man, ten years' experience and has always got good results by original money saving methods. Address Box 323, AMERICAN MACHINIST.

NEW JERSEY

Chief draftsman and designer desires change. Address Box 320, AMERICAN MACHINIST.

Competent, experienced mechanical draftsman, 28, technical graduate, desires change at $21.00 to start. A. Werner, 228 Clark Place, Elizabeth, N. J.

Wanted—Position by young man (27) as assistant to mechanical engineer (textile plant preferred). Technical training, seven years' experience, shop, drafting room and field. Address Box 326, AMERICAN MACHINIST.

Foreman toolmaker wants responsible position. First-class designer of dies, tools, jigs and labor-saving devices of any description. Long experience as executive and modern shop methods. Box 329, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wants position in country. Address "M. E.," Box 317, AM. MACH.

Photographer, commercial. Dry plates; desires position. Address "Photographer," AMERICAN MACHINIST.

Student in I. C. S. has finished the mechanical drawing course, desires position as draftsman. Age 20; references. Box 310, AMER. MACH.

Mechanical engineer, expert designer of high speed steam engines, 26 years old, wants position. Salary $20 weekly. No limit as to location. Address Box 324, AMER. MACH.

High grade designer, twelve years' all-round experience, steam turbines, steam engines, special machinery, automatic machinery, wishes position where originality and utility count. Box 330, AMERICAN MACHINIST.

Assistant superintendent desires change; technical man with fifteen years' experience in the manufacture of sewing machines and firearms. Expert in the designing of special and automatic machinery, small tools, etc. Age 38. Address Box 322, AMERICAN MACH.

OHIO

Wanted—Position as general foreman. Ten years' shop experience, technical graduate, reference furnished, married, will go anywhere. "L. B. S.," care AMERICAN MACHINIST.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

Engineer, draftsman, University graduate, eight years' experience along general lines, presses, dies, rolling mills in steel mill, shop engineering. Highest reference. Box 301, AMERICAN MACHINIST.

WISCONSIN

Position as superintendent by a high grade practical man. Organizer, systematizer, executive. Box 299, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Draftsman wanted. One who has had experience in a.c. and d.c. mechanical design. Apply by letter to the undersigned, stating age, experience, references and salary expected. Canadian General Electric Co., Ltd., Peterboro, Ont.

ILLINOIS

Exceptionally well qualified designer, capable of originating complete line of rotary and jaw shears, punches, bending rolls, flangers, riveters, and auxiliary equipment used in boiler and structural shops. State education, experience, age and expectations first letter. Mere job hunters need not apply. Box 292, AM. MACH.

Wanted—Diemaker with inventive ingenuity, experience and ability to devise and design fine dies for factory producing high class goods from sheet silver. Must also be capable and experienced in handling output and reducing factory costs generally. High pay, permanency and advancement with growing company. References and particulars required. Address Box 314, AMERICAN MACHINIST.

INDIANA

Wanted—An experienced foreman for machine shop manufacturing gasolene motors. Address Box 334, AMERICAN MACHINIST.

MASSACHUSETTS

First-class designer of jigs and fixtures wanted for permanent position in Massachusetts. Only experienced, capable man need apply by stating age, education, previous experience and salary expected. Address Box 312, AMER. MACHINIST.

Wanted—As shop superintendent or general foreman, a man who has a successful record in manufacturing monkey wrenches and similar work. Forge and foundry experience is not absolutely necessary. Plant is new and modern and is now running day and night. Do not apply unless thoroughly competent to take charge of 100 men and make good in quantity, price and quality of output. Give outline of record, references and mention salary desired. Box 286, AMERICAN MACHINIST.

MICHIGAN

Wanted—Foreman machinist to invest $1000.00 in good manufacturing business and take full charge of machine shop. Must understand hydraulic press work, and have some knowledge of woodworking machinery. None but first class men with good reference need apply. Box 313. AMERICAN MACHINIST.

NEW YORK

Man to sell patented specialty used in all machine shops. Good opportunity for a hustler. Applicant must state age, experience and salary expected. "Mechanic," Box 333, AM. M.

Wanted—Foreman of milling machine department in large automobile factory; must be a hustler and produce results by use of high-speed cutters and modern methods. Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—A resourceful, experienced man to superintend a large established metal drawing, stamping and finishing plant. Must be able to handle men and know how to obtain results. Address "Drawn Work," AMERICAN MACHINIST.

Engineer wanted by a company designing and manufacturing both steam and electric machinery. He should have a thorough, technical education, experienced in shop practice and have marked executive ability. The work is strenuous, and calls for a young man. Salary $3000.00. Address Box 332, AMERICAN MACHINIST, with list of references.

Casualty Insurance Company invites applications for vacancy in Inspection Department from superintendents and foremen of manufacturing plants having extensive experience in the erection and operation of machinery. Full details of experience, salary expected and references must be given to obtain consideration. Box 311, AMERICAN MACHINIST.

OKLAHOMA

Wanted—Toolmaker and machinist. Young married man preferred. State experience and wages expected. Address R. E. Chandler, Stillwater, Oklahoma.

PENNSYLVANIA

Wanted—Foreman for modern foundry making engine castings; capacity 20 to 25 tons. A very desirable place for the right man. Box 319, AMERICAN MACHINITT.

Foreman for erecting heavy machine tools; must be experienced on accurate machine tool work, with ability to increase production and efficiency; state age, experience and salary expected. Box 278. AMERICAN MACHINIST.

For Sale

Castings and prints for 8-inch foot lathe. W. E. Morey, 2563 Trink St., Chicago, Ill.

For Sale—A variable speed. New patent. No gingerbread about this. Will pay you to investigate. Address Box 321, AM MACH.

Old-style Wheeler planer, 22x5', $150.00; 1 Fitchburg shaper, 12"x16", $35.00; 1 small wet tool grinder, $20.00. Samuel M. Langston, Camden, N. J.

For Sale—Manufacturing plant equipped with electric power, machine, boiler, blacksmith, pattern, woodworking shops. Foundry and storage, with machinery, tools and stock, or plant only. Railroad switch in yard. Shipping facilities by rail, lake or canal. Address Box 318, AMERICAN MACHINIST.

Small Tools—A very complete outfit of small tools, including calipers, micrometers, gages, drills, reamers, taps, dies, wrenches, hammers, squares, bevels, lathe tools, as well as an assortment of carpenters' and pipers' tools, suitable for a repair shop, tool room, or foreman. Will sell entire lot or divide as desired. All are of the very best quality, and in good condition, many being entirely new. Address Box 113, Southbridge, Mass.

Machinery for sale at the Kokomo, Indiana, Works of the Pittsburgh Plate Glass Company. 1 L. H. 30x60 E. P. Allis girder frame Corliss engine, 24' fly-wheel; 1 L. H. 10x30 E. P. Allis girder frame Corliss engine, 12' fly-wheel; 1 G. F. Blake 9x20x12 duplex vertical air pump; 1 E. P. Allis vertical surface condenser, 2700 sq.ft.; 1 15x18 high speed piston valve Beck engine; 1 10x18x14 tandem compound self-oiling Fisher automatic engine; 1 14x10x12 Smith-Vaile duplex steam pump; 1 R. H. Rankin & Fritsch 14x20 Tangye frame slide valve engine; 1 L. H. Rankin & Fritsch 14x20 Tangye frame slide valve; 1 13x20 box bed R. H. Mansfield throttling engine; 1 12x20 box bed L. H. Mansfield throttling engine; 7 14x24 Atlas box bed slide valve engines L. H.; 7 14x24 Atlas box bed slide valve engines R. H.; 1 Laidlaw-Dunn-Gordon 14x22x18 duplex air compressor; fly-wheel type air cylinder, unjacketed; 1 Dean Steam Pump Co. 12x7x10 duplex pump, just out of repair shop; 1 6x4x6 Worthington duplex steam pump; 1 Dean Steam Pump Co. 10x6x10 duplex steam pump; 8 Cahall vertical water tube safety boilers, 250 h.p. each. Inquire about above of W. D. Hartupee, 2d Vice Pres., Pittsburgh Plate Glass Co., Frick Building, Pittsburgh, Pa

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Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.

Arbor Presses—*Continued.*

Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
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Cleveland Twist Drill Co., Cleveland, O.
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Pratt Chuck Co., Frankfort, N. Y.
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Lyon Metallic Mfg. Co., Aurora, Ill.

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Globe Machine & Stamping Co., Cleveland, O.

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Hyatt Roller Bearing Co., Harrison, N. J.

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The L. & D. Co., Boston, Mass.

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Manufacturing Equipment & Engineering Co., Boston, Mass.

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Bending Machines, Power
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blocks, Die
Nicholson & Co., W. H., Wilkes-Barre, Pa.

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American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Brothers & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

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Foote-Burt Co., Cleveland, O.
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Landis Machine Co., Waynesboro, Pa.
Manville Mach. Co., E. J., Waterbury, Conn.
McCabe, J. J., New York.
Milton Mfg. Co., Milton, Pa.
Mummert, Wolf & Dixon Co., Hanover, Pa.
National-Acme Mfg. Co., Cleveland, O.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads
Lang & Co., G. R., Meadville, Pa.

Bolts and Nuts
Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Technical
Hill Publishing Co., New York.
Sames, Chas. M., Jersey City, N. J.

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Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Boynton & Plummer, Worcester, Mass.
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Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

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McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Newton Machine Tool Wks., Inc. Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Philadelphia, Pa.
Vandyck Churchill Co., New York.

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Krieger Tool & Mfg. Co., Chicago, Ill.

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Bardons & Oliver, Cleveland, O.

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Industrial Oxygen Co., New York

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Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

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Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels.

Carborundum Paper and Cloth
Carborundum Co., Niagara Falls, N. Y.

Case-Hardening
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Rogers & Hubbard Co., Middletown, Conn.
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Lumen Bearing Co., Buffalo, N. Y.

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Franklin Mfg. Co., H. H., Syracuse, N. Y.

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Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Ct.

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Cammel, Laird & Co., New York.

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Industrial Oxygen Co., New York.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

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Whiton Mach. Co., D. E., New London, Conn.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

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Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

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Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Warner & Swasey Co., Cleveland, Ohio.
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Jacobs Mfg. Co., Hartford, Conn.
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Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
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Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Harrington & Son Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven Conn.
Niles-Bement-Pond Co., New York
Skinner Chuck Co., New Britain Conn.

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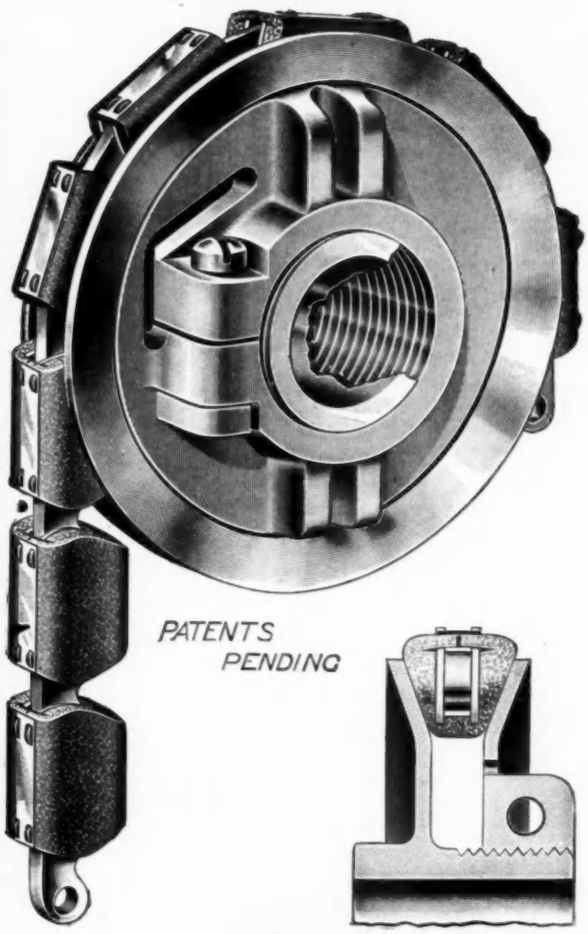

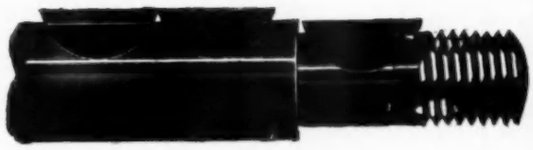

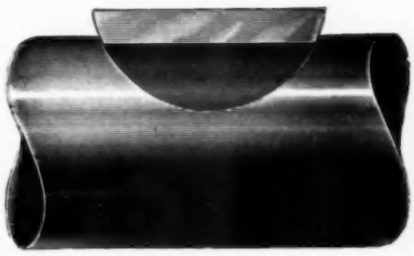

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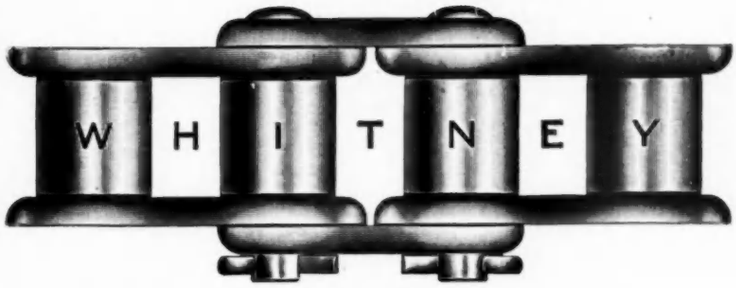

"Whitney" Patent Cotter Detachable Roller Chains

Made a fine record in the Briarcliff Road Race.

THE WHITNEY MFG. COMPANY,
Hartford, Conn.

New York City, May 2, 1908.

Gentlemen—The uniform strength of an automobile driving chain is one of the important requisites in a speed contest.

The "Whitney" Chains which formed a part of the equipment on our three "Stearns" Cars in the recent Briarcliff Stock Car Road Race, showed their superiority by coming through this exceptionally difficult contest without the slightest evidence of the terrific strain which they had undergone. Our "Stearns" Cars made an exceptional showing in this race, and we attribute our success in no small degree to the entire absence of chain trouble.

Our experience in previous contests has taught us that a faulty chain can cause a lot of trouble.

We therefore take this opportunity to express the satisfaction which we feel at the manner in which "Whitney" Chains demonstrated their worth.

Yours very truly,
WYCKOFF, CHURCH & PARTRIDGE,
By C. F. Wyckoff, President.

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Corundum
See Grinding Wheels.

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McCabe, J. J., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

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Couplers, Hose
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

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Davis Machine Co., W. P., Rochester, N. Y.
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Cranes
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Case Mfg. Co., Columbus, O.
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Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.

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Obermayer Co., S., Cincinnati, O.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O
Paxson Co., J. W., Phila., Pa.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker Milling Machine tCo., Hyde Park, Mass.
Bliss Mfg. Co., E. C., Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Owen Machine Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno M., Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son. Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.

Dies, Sub-Press
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.

Dies, Threading, Opening —*Continued.*
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.

Drawing Materials
Alteneder & Son, Theo.; Philadelphia, Pa.
Kolesch & Co., New York.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler
American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc.. James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa,
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co. Cleveland, O.

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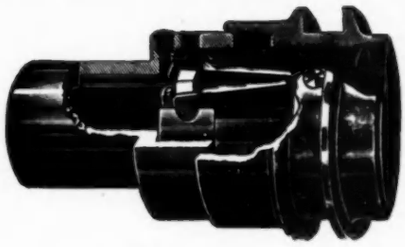
Philadelphia, Pa., U.S.A.

THE JOHNSON FRICTION CLUTCH



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Because the use of high speed steels has become necessary, more powerful clutches are required. To meet all the needs of modern machinery the Johnson Friction Clutch was designed, and its present perfection is proved by its almost universal use. ¶ The "Johnson" has won out because it is simple (see lower illustration), powerful, compact and neat, because it operates quietly and perfectly at any speed; because it has no projecting parts, no bolts, nuts, links, etc., to cause trouble; because it is dirt and dust proof; because it runs without vibration.

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Drilling Machines, Radial —Continued.

Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hilbert Mach. Co., Cincinnati, Ohio
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Rail

Foote-Burt Co., Cleveland, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Shepard Electric Crane & Hoist Co. Montour Falls, N. Y.
Standard Tool Co., Cleveland, O.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Celfor Tool Co., Chicago, Ill
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

Drills, Flat

Celfor Tool Co., Chicago, Ill.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co. B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Works Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L. New York.
Safety Emery Wheel Co., Springfield, O
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room

Hart & Cooley Co., New Britain, Conn.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical

Crocker-Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Engines, Steam

Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Eyelet Machinery

Manville Bros. Co., Waterbury, Conn.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Simonds File Co., Fitchburg, Mass.

Filing Machines

Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Philadelphia, Pa.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N.Y.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Steel

Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa
McInnes Steel Co., Corry, Pa.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Goldschmidt Thermit Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J.W., P hila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Frictions, Paper and Iron

Rockwood Mfg. Co., Indianapolis, Ind.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Tate, Jones & Co., Pittsburg, Pa.
U. S. Gas Furnace Co., Providence, R. I.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling

American Gas Furnace Co., New York.
U. S. Gas Furnace Co., Providence, R. I.

Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Furnace Co., New York.
U. S. Gas Furnace Co., Providence, R. I.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Oil

Rockwell Furnace Co., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

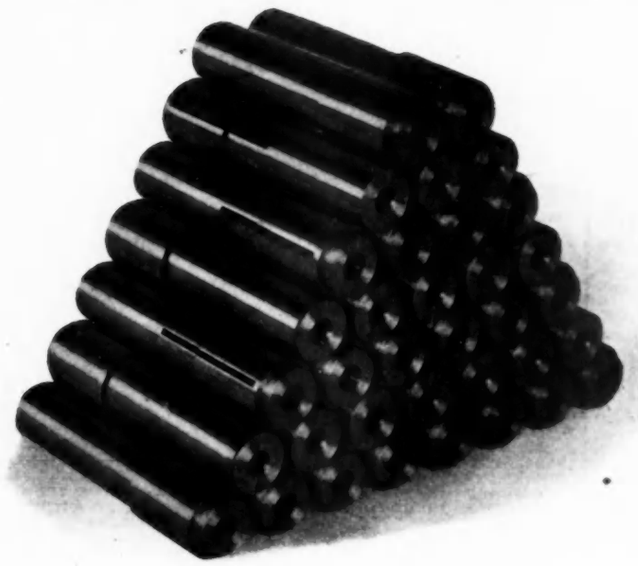
Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Ames & Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

GRINDING MACHINE SPINDLES



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They were HARDENED, 40 point carbon steel, $1\frac{7}{8}$" and $2\frac{1}{8}$" dia. by $8\frac{3}{4}$" long.

Ground to a fine finish, including No. 3 Morse Taper hole in one end which was ground to gauge fit.

Limit variation .00025".

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AVERAGE GRINDING TIME, 15 MINUTES.

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New Pattern "Reed" Lathe

SIMPLICITY. STRENGTH.
SERVICE. SATISFACTION.

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Gages, Standard —*Continued.*

Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam

Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Gear & Pattern Works, Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati, Ohio.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston, Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Gear & Pattern Works, Buffalo, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Owen Machine Tool Co., Springfield, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Gears, Molded —*Continued.*

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co, McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O

Grinders, Cutter

Becker Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co, New York.
Rivett Lathe Mfg. Co., Boston, Mass.

Grinders, Cutter—*Continued.*

U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc

Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Ohio
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Iroquois Mach. Co., Providence, R. I.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife

American Wood Working Mchy. Co., Rochester, N. Y.
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S. Electrical Co., Cincinnati, Ohio.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co. Worcester, Mass
Rivett Lathe Mfg. Co., Boston, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Tabor Mfg. Co., Phila., Pa.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grinders, Tool —*Continued.*

Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding or Polishing Machinery

Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Chicago Machine Tool Co., Chicago, Ill.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Machine Co., Providence, R. I.
Gardner Mach. Co., Beloit, Mich.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Grinding Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Roth Bros. & Co., Chicago, Ill.
Safety Emery Wheel Co., Springfield, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Machine Co., Providence, R. I.
Dickinson, Thos. L., New York.
Niles-Bement-Pond Co., New York
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstones and Frames

Cleveland Stone Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.

Gun Barrel Machinery

Diamond Machine Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Hammers, Drop

Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Bliss Co., E. W., Brooklyn, N. Y.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.